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Vol. 3

BULLETINS
OF
AMERICAN PALEONTOLOGY

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No. 11

THE LIGNITIC STAGE

PART II

Scaphopoda, GASTROPODA, Pteropoda and Cephalopoda

BY

G. D. HARRIS

May 4, 1899

Ithaca, N. Y.
U. S. A.

THE LIGNITIC STAGE.

BY

Gilbert D. Harris.

PART II.

Scaphopoda, GASTROPODA, Pteropoda and Cephalopoda.

PRELIMINARY CONSIDERATIONS.

Part I, on the Lignitic Pelecypoda, was published as Bulletin No. 9 (June 15, 1897) and hence forms a part of volume 2. It would have been better, doubtless so far as convenience of reference is concerned, could the present work have followed as Bulletin No. 10, thus having a continuous pagination with No. 9. This, however, seemed impossible for want of time for its preparation during the fall of 1897; hence another took its place, and this is of necessity relegated to vol. 3.

The general plan and purpose of these publications has already been duly set forth. We may therefore proceed directly to the subject matter of this paper as designated by the above-given title.

Scaphopoda.

DENTALIUM.

Dentalium microstria, Pl. 1, fig. 1, a.

Syn. *D. microstria* Heilp., Proc. Ac. Nat. Sci. Phila., 1880, p. 375, pl. 20, fig. 3.

D. microstria Ald., Bull, Am. Pal.. vol. 1, p. 55, pl. 2, fig. 6.

Heilprin's original description.—"Shell slender, considerably curved and greatly attenuated, faintly striated, the striæ most conspicuous on the attenuated portion; posterior aperture entire, there being no fissure; anterior aperture circular.

"Length, 1½ to 2 inches. Cave branch; Woods bluff, Clarke Co., Ala."

This, as the figure shows is of a slender form, with surface nearly or quite smooth except at the smaller extremity, where five sometimes equal, but generally alternating longitudinal lines are found extending from ½ to ¾ of an inch from the apex. This posterior or lesser termination is usually not entire; but when intact it shows a comparatively shallow slit on the ventral or ex-curved side as indicated by pl. 1, fig. 1, a.

When broken posteriorly an internal accessory tube is often seen projecting beyond the exterior shell.

Localities.—ALA.: Woods bluff; Cave branch, (Heilprin): Choctaw Corner; Bethel; 4 mi. S. of Mt. Sterling; Hendrick's marl bed; Butler; ½ mi. S. of Butler (Aldrich): Hatchetigbee bluff; 4 miles N. of Hamilton bluff (Harris.)

Type.—

Specimen figured.—Woods bluff, Ala.; Paleont Mus., C. U.

Dentalium thalloides, Con.

Syn. *D. thalloide* Dall, Trans. Wag. Free Inst. Sci., vol. 3, pt. 2, p. 438, 1883.

Dall says (*op. cit.*): "*D. thalloide* Conrad (*D. alternatum Lea*) is very common in the Claibornian at Claiborne, near Clarksville and Woods bluff, Alabama, Wautubbee and Newton, Miss., and Creole Bluff, Louisiana."

Leaving aside the question as to whether "very common" applies to the Woods bluff locality or not, it seems to us doubtful whether this species has been found at this locality at all. Our enormous quantities of material from that outcrop fail to yield a single specimen; nor have Aldrich's researches brought any to light. The Eocene from Alabama collected by L. C. Johnson and now in the U. S. Nat. Museum was often improperly localized and this may account for the citation of the species at this locality.

Dentalium multannulatum, Pl. 1, fig. 2.

Syn. *D. multannulatum* Ald., Bull. Am. Pal., vol. 1, p. 55, pl. 2, fig. 3.

Aldrich's original description.—*Op. cit.*

Locality.—ALA.: Gregg's landing.

Specimen figured.—Aldrich's collection.

CADULUS.

Cadulus abruptus, Pl. 1, fig. 3

Syn. *C. abruptus* Ald. & M., Jr. Cinn. Soc. Nat. Hist., vol. 9, p. 104, pl. 2, fig. 2, 1886.
C. subcoarctatus Ald., *partim*, Bull. Am. Pal., vol. 1, p. 56, pl. 2, fig. 2, 4?

Aldrich and Meyer's original description.—"Rather large, somewhat depressed. Inflation very near to the large aperture and suddenly decreasing. Newton, Wautubbee.

"The type specimen is from Newton. Form and position of the inflation distinguish it from other species of *Cadulus* of the southern Tertiary." Dall regards this the same as Gabb's *Ditrupa subcoarcuata* from Texas, an older name than *abruptus*. Aldrich has accepted that view, (*loc. cit.*) though from what he says it seems that he may be mistaken as to the identification of *subcoarcuatus*. While studying over the large amount of Eocene material of the Texan State survey we were led to consider the two species distinct. Dall very properly notes that the species "is notable for having the smaller end lightly longitudinally striated in most specimens." This is especially true of the Woods bluff forms, but was not observed by the writer in his Texas lower Claiborne specimens, nor on a good specimen from Gregg's landing.

Lignitic localities.—Ala.: Woods bluff, Gregg's landing; 4 miles above Hamilton bluff on the Alabama. From the last locality the specimen are exceedingly small and slender. 1¼ mi. W. S. W. of Choctaw Corner, Ala.

Type.—Aldrich's collection.

Specimen figured.—Woods bluff; Paleont. Musuem, Cornell University.

GASTROPODA.

ACTÆON.

Actæon idoneus, Pl. 1, fig. 4.

Syn. *A. idoneus* Con., Foss. Sh. Tert. Form., pt. 4, p. 45, Nov., 1833.
A. lineatus Lea, Cont. to Geol., p. 112,. pl. 4, fig. 97, Dec., 1833.
A. punctatus Ald., Geol., Surv. Ala., Bull 1, p. 53, 1886.

Conrad's original description.---"Narrow-elliptical, with narrow transversely striated sulci, which are distant on the superior portion of the body whorl; fold on the columella elevated and very obtuse; labrum thickened." From the Claiborne sand bed.

In a forth-coming report we shall have more to say regarding the synonymy of *idoneus* and *pomilius* of Conrad and *lineatus* and *punctatus* of Lea. They all grade exceeding near to one another. Suffice it to say here that these Lignitic specimens vary somewhat in form, have an obtuse, not prominent fold, are marked exteriorly as follows—beginning with the suture of the body whorl and passing downwards: 1, two or three rather close-set revolving lines on the shoulder and near the suture; 2, one or two broad interspaces with the posterior termination of the mouth following the third of these lines with broad interspaces; 3, on the remaining and lower part of the whorl there are often about ten revolving lines usually decreasing in strength and width of interspace going downwards; often a fine secondary system of spiral lines is here visible. In the larger revolving lines there are microscopic transverse striations. Lines of growth practically invisible even under a glass. The arcuate form of the labrum and the occasional irregularities of growth show that such lines if visible would curve backward or to the right in passing over each whorl to the suture above.

Locality.—ALA.: Woods bluff.

Type.—Acad. Nat. Sci., Phila.

Specimen figured.—Woods bluff; Paleont. Mus., Cornell Univ.

"Actæon" cossmanni, Pl. 1, fig. 5.

Syn. *A. cossmanni* Ald., Bull, Am. Pal., vol. 2, p. 176, pl. 3, fig. 5, 1897.

Aldrich's original description.—Op. cit.

I have not seen the type specimen, nor have any specimens of the species appeared in our collections. The straight columella, the pointed anterior portion of the aperture, the lack of any trace of a columellar fold, and the "shining" spiral surface are characters somewhat remarkable for this genus. See original description.

TORNATELLÆA.

Tornatellæa bella, Pl. 1, fig. 6.

Syn. *Tornatellæa bella* Con., Jr. Ac. Nat. Sci. Phila., 2d, ser., vol. 4, p. 294, pl. 47, fig. 23, 1860.

T. (*Tornatellæa*) *bella* Heilp., Proc. Ac. Nat. Sci. Phila., 1880, p. 364, 366.

T. (*Tornatellæa*) *bella* Ald., Geol. Surv. Ala., Bull. 1, p. 53, 1886.

Conrad's original description.—(See Bull. Am. Pal., vol. 1, p. 188.)

Lignitic localities.—ALA.: Woods bluff; mouth of Bashi creek; Hatchetigbee bluff; 1¼ mi. W. S. W. of Choctaw Corner. Aldrich gives the following additional localities: Bethel; 4 mi. S. of Mt. Sterling; Hendrick's marl bed; ½ mi. S. of Butler. Knight's branch, (Heilprin.)

Type.—Acad. Nat. Sci. Phila. Conrad's original label reads simply "Tornatellæa bella Con. Alab." Heilprin has improperly added "Claiborne."

Specimen figured.—Woods bluff; Pal. Mus., Cornell University.

VOLVARIA.

Volvaria (Volvariella) alabamensis, Pl. 1, fig. 7.

Syn. *V.* (*Volvariella*) *alabamensis* Ald., Bull. Am. Pal., vol. 2, 179, pl. 3, fig. 3, 1897.

Aldrich's original description.—*Op. cit.*

Localities.—ALABAMA: Choctaw Corner,—Aldrich and C. W. Johnson.

Type.—Aldrich's collection.

TORNATINA.

Tornatina leai, Pl. 1, fig. 8.

Syn. *Bullina leai* Ald., Bull. Amer. Pal., vol. 1, p. 59, pl. 3, fig. 6, 1895.
Tornatina leai Cossm., Rev. Bibliog. pour l'Annee, 1895, p. 34.

Aldrich's original description.—*Op. cit.*

The revolving lines on the posterior part of the body whorl are extremely minute, in fact scarcely more conspicuous than those on the middle portion of the shell. There is, however, a slight constriction about the shell which marks off this posterior portion definitely. The specimen figured pl. 3, fig. 6, shows more or less of a collosity near the anterior portion of the labium, but in the specimen herewith figured this is much less marked.

Localities.—ALA.: Bell's landing; Yellow bluff.

Types and specimen figured.—Bell's landing; Aldrich's collection.

SCAPHANDER.

Scaphander alabamensis, Pl. 1, fig. 9.

Syn. *S. alabamensis* Ald., Bull. Am. Pal., vol. 1, p. 58, pl. 3, fig. 2, 1895.

Aldrich's original description.—Op. cit.

We are able to add little to Aldrich's remarks, which see. The obliquity of the growth lines is rather noteworthy however. It lacks the strong, sharply incised spiral lines of *ligniticus*, though faint ones are numerous. Our figure of the shell is taken from a slightly different standpoint than that given on pl. 3, vol. 1.

Locality.—ALA.: Gregg's landing.

Type.—Aldrich's collection.

Specimen figured.—Aldrich's collection.

Scaphander ligniticus, Pl. 1, fig. 10.

Syn. *S. ligniticus* Ald., Bull. Am. Pal., vol. 2, p. 177, pl. 3, fig. 4, 1897.

Aldrich's original description.—(*Op. cit.*)

We have not seen Aldrich's type of this specimen but we have several very good specimens, young and old, belonging to it. A smooth shining, porcelaneous incrustation is found covering the specimens from 4 miles above Hamilton bluff.

Localities.—ALA.: Woods bluff; 1¼ mi. W. S. W. of Choctaw Corner; 4 mi. above Hamilton bluff.

Type and specimen figured.—Not in the type lot of Lignitic Eocene materal sent by Aldrich. He mentions, *loc. cit.*, a specimen in the National Museum.

ATYS.

Atys robustoides, Pl. 1, fig. 11.

Syn. *A. robustoides* Ald., Bull. Am. Pal., vol. 1, p. 58, pl. 3, fig. 4, 4a, 1895.

Aldrich's original description.—Op. cit.

Locality.--ALA.: Gregg's landing.

Type and specimen figured.—Aldrich's collection.

CYLICHNA.

Cylichna sylværupis, n. sp., Pl. 1, fig. 12.

Syn. *C. galba* Ald. *non.* Con., Geol. Sur. Ala., Bull. No. 1, p. 53, 1886.

Specific description.---Form and size as indicated by the figure; surface more or less spirally striate above, medially nearly smooth or microscopically striate, below with striæ becoming coarser and deeper to base; spire involute; posterior narrowing; columellar collosity depressed medially forming on either side low faint ridges or folds as in *Cylichnella*, the lower after curving downward becoming confluent with the anterior margin of the labrum, the upper becoming obsolete at the outer margin of the labium.

Differs from *galba* in its more constricted posterior; presence of striation above or on the posterior; presence of a depression (bounded by incipient columellar folds) where in *galba* a large obtuse fold is found.

Localities.—ALA.: Woods bluff, Gregg's landing, and according to Aldrich, at Bell's landing also.

Type and specimen figured.—From Woods bluff; Paleont. Museum, Cornell University.

Cylichna aldrichi, Pl. 1, fig. 13.

Syn. *Bulla (Haminea) aldrichi*, Lang., Am. Jr. Sci., 3d ser., vol. 31, p. 209, 1886.
Cylichna aldrichi Ald., Bull. Am. Pal., vol. 2, p. 173, pl. 5, fig. 5, 1897.

Langdon's original description.—"Shell elongate oval, substance rather thin, punctate-striate, striæ about 20, transverse; spire involute; labrum sharp and slightly dentate; mouth longitudinal and rather larger at base than at top; columella very slightly thickened at the base. Height .2; Breadth .1.

Resembles *B. glaphyra* Desh., but differs in the striæ which are in *B. aldrichi* from the top to the bottom, while in *B. glaphyra* Desh, they are confined to the upper and lower thirds of the shell."

Langdon gives no locality under this description but Aldrich says of the specimen he figures "from Choctaw Corner, Ala., where it is rather common."

Localities.—ALA.: Woods Bluff; 4 miles above Hamilton bluff, Alabama river; 3 miles S. W. of Thomasville, Ala.

Type.—Aldrich's collection?

Specimen figured.—The figure is a reprint of fig. 5, pl. 5, vol. 2.

RINGICULA.

Ringicula butleriana var. **lignitifera.** Pl. 1, fig. 14.

Syn. *R. butleriana* var. *lignitifera* Ald., Bull. Am. Pal., vol. 2, p. 176, pl. 3, fig. 9, 1897.

Aldrich's original description.—Op. cit.

Our specimens from 4 miles above Hamilton bluff on the Alabama are much smaller than the dimensions indicated by the figure but seem to agree very well in other respects with this variety.

Ringicula butleriana, Pl. 1, fig. 15.

Syn. *R. butleriana* Ald., Bull. Am. Pal., vol. 1, p. 59, pl. 2, fig. 8, 1895.

Aldrich's original description.—Op. cit.

The specimens in our collections belonging to this species, if the smoothness of the labrum is taken solely into account, are from Woods bluff. But the height of the spire indicates a close affinity and probable identity with var. *lignitifera* Ald.

Type.—The type specimen in Aldrich's collection is labelled "½ mi. S. of Butler, Ala.; W. B. Gr."

PHILINE.

Philine alabamensis, Pl. 1, fig. 16.

Syn. *P. alabamensis* Ald., Bull. Am. Pal., vol. 2, p. 176, pl. 6, fig. 6, 1897.

Aldrich's original description.—Op. cit.

Our sepcimens were obtained from 1¼ mile W. S. W. of Choctaw Corner and hence probably from the same locality as Aldrich's type. In ours however the posterior constriction is much more plainly marked than the figure would indicate, it being that of Aldrich's type by Dr. McConnell.

UMBRELLA.

Umbrella sylværupis, n. sp. Pl. 1, fig. 17, a, b.

Specific characterization.—Size and general form as indicated by the figures; muscular marking but slightly impressed in an arc of about 50° above, as oriented on the plate, the same space as viewed from the exterior being slightly depressed; two radiating depressions on the opposite side of the beak enclose an angle of about 30°.

This is smaller, and less circular in outline than *U. planulata* Con. from the Jackson beds.

Locality.—ALA.: Woods bluff.

Type.—Woods bluff, Ala.; Paleont Musuem, Cornell University.

PLEUROTOMA.

Pleurotoma mediavia, var., Pl. 1, fig. 18.

Syn. *P. mediavia* Har., Bull. Am. Pal., vol. 1, p. 193, pl. 17, fig. 16.

Harris' original description. Loc. cit.

Reference was made in the original description to a form of the Lignitic stage at Woods bluff which seemed very nearly allied to the Midway type. The differences between the two are chiefly: the larger size of the Lignitic form, its less number of revolving striæ and its rather more pronounced costæ and a slightly raised spiral band below the suture. The two can however be referred with safety to the same species. The costæ are figured too strongly developed for the majority of specimens in our collections.

Localities.—ALA.: Woods bluff, abundant; 3 mi. S. W. of Thomasville.

Figured specimen.—Paleontological Musuem, Cornell Univ.

Pl. mediavia, var. **equiseta**, n. var., Pl. 1, fig. 19.

Differs from *mediavia* by its greater size, its very much finer costations, especially on the 4th embryonic whorl, its coarser spiral lines which are more or less alternate in size and are strangely granular like the exterior of "rushes"; the carination on the upper whorls especially in the upper spirals is lower down than in *mediavia*. Yet the two forms have a very similar general appearance.

This form is most strikingly similar to *P. watelcti* Desh., of the Sables inférieurs at Cuise-la-Motte. So far as can be judged from Deshayes' description and figure the only points of variance are the proportion of the body whorl to the remainder of the shell, and its size. Our shell is not 51 mm. long nor is the body whorl proportionally so large.

Localities.—ALA.: Woods bluff; Hatchetigbee.

Type.—Woods bluff; Paleont. Mus., Cornell University.

Pleurotoma moniliata, Pl. 1, fig. 20.

Syn. *P. moniliata* Heilp., Proc. Ac. Nat. Sci. Phila., 1880, p. 373, pl. 20, fig, 9.
P. moniliata Ald., Geol. Sur. Ala., vol. 1, 1886, p. 52,

Heilprins' original description.—"Shell fusiform, elevated, of about eight volutions, the whorls considerably contracted above the shoulder; whorls ornamented with a double series of nodes, the lower much the most strongly developed, which gives to the upper portion of the spire a moniliform appearance; surface of entire shell traversed by fine revolving lines, which become more distant, very prominent, and alternate on the median portion of the body-whorl; aperture about the length of spire; the relative position of the upper and lower nodes correspond to the sinuous lines of growth.

"Length, 1 inch. Cave branch, Clarke Co., Ala."

In rare instances the costation of the body whorl resembles that of *mediavia*, or *childreni*.

Localities.—ALA.: As above, and especially Woods bluff.

Type.—

Specimen figured.—Woods bluff; Paleont. Mus., Cornell Univ.

Pleurotoma denticula, var., Pl. 1, fig. 21, 22.

Syn. *P. denticula* Edw., Paleont. Soc. Lond., vol. XXI, p. 286, pl. 30, fig. 7, a-h, 1860.
? *P. denticula* Bast., Descr. Geol. du Bass. Tert. Sud-ouest de la France, p. 63, pl. 3, fig. 12, 1825.—*Fide* Edw.
P. alternata Con., Foss. Sh. Tert. Form., p. 46, 1833. 2d ed. p. 50, pl. 17, fig. 13, 1835.
P. childreni Lea, Cont. to Geol. p. 137, pl. 4, fig. 132, 1833.
P. acutirostra Con., Foss. Sh. Tert. Form., p. 52, pl. 17, fig. 21, 1835.
P. plebeia Dixon, Geol. Sussex, p. 184, pl. 6, fig. 23, 1850.
P. denticula Heilp., Proc. Ac. Nat. Sci. Phila., 1879, p. 214, p. 13, fig. 10.
P. denticula Meyer, Proc. Ac. Nat. Sci. Phila., 1884, p. 106.

Not having Basterot's original description, or specimens from his type locality it is impossible at present to say from personal observation whether our specimens can be referred to his species or not. On the other hand it seems quite safe to say that ours and some of the varieties referred to *denticula* by Edwards from the English Eocene are the same. My foreign specimens are from the Barton beds of southern England and Alum bay, Isle of Wight, and are considerably shorter proportionally than are the American, but on the whole the differences seem to be of degree and not of total absence of features in one and not in the other. De Gregorio speaks (Mon. Faun. Eoc. Ala., p. 25) of the apparent identity of *childreni* and *denticula*. Cossmann admits that the two belong to the same section but notes the more distant crenulations of the latter. This distinction does not however hold when the Lignitic Eocene specimens are taken into consideration. Dixon's figure of *plebeia* is a splendid representation of some of our Lignitic forms. Heilprin remarks that Gabb's *nodocarinata* from Texas belongs to this species. This however is a mistake and has already been accounted for (Proc. Ac. Nat. Sci. Phila., 1895, p. 59).

Strangely enough neither Meyer nor Heilprin mention the identity of *childreni* and *denticula*, but Meyer regards the latter as equivalent to *P. baumonti* Lea. *P. baumonti* is probably but a well marked variety of *denticula* or *childreni*, but with its one spiral passing through obique nodules it varies considerably from *denticula*. A variety of the same has recently been figured by Vaughan as *P. learchi* (Bull. Geol. Surv. No. 142, pl. 2, fig. 1, 1896). Gregorio's comparing *childreni* with *nupera* Con. and *terebratis* Lam. is inexcusable.

Other forms will be noted in our monographs on the Lower Claiborne and Claiborne stages. When all available American material has been worked over several varietal names can well be given to this variable species.

Lignitic localities.—ALA.: Woods bluff, Gregg's landing.

Specimen figured.—Pl. 1, fig. 21, Woods bluff; fig. 22. Gregg's landing: Paleontological Museum, Cornell Univ.

Pleurotoma nebulosa, n. sp., Pl. 2, fig. 1.

Specific characterization.—Size and general form as indicated by the figure; whorls 9; 1, 2, and 3, smooth, small; 4, 4½ faintly plicate longitudinally above but more strongly so below; remaining whorls ornamented by ribs strongest in a medial portion of the whorl, slightly obliquely set, extending faintly to the left and above to the sub-sutural band where a nodular enlargement takes place; above, the ribs extend nearly from suture to suture, below, they are more limited and sometimes nearly vanish on the body whorl; ribs more or less angular centrally, giving the whorl a carinated appearance, crossed by many faint revolving lines above the carina, and by much coarser ones on the carina and below; lines of growth nearly obliterated by the spirals; mouth about one half the length of the whole shell.

It is with great reluctance that we propose a new name for this seemingly common type of *Pleurotoma*. Small specimens of this genus with two rows of nodules, one sub-sutural, the other carinal are common indeed in our Claiborne and other Eocene deposits; great variation moreover is shown among different specimens of this form; but it will be observed that the variation from the type specimen figured is toward the *moniliata* style of ornamentation; the great length of mouth in proportion to the height of spire, the coarseness and central carination of the ribs, the convex rather than concave sides of the spire, and other less noticeable features are not at all in harmony with the Clairbornian *rugosa* Lea, *nupera* Con., etc., etc.

Localities.—ALA.: Woods bluff ;3 mi. S. W. of Thomasville.

Type and specimen figured.—Woods bluff: Paleontological Museum, Cornell Univ.

Pleurotoma vaughani var. **sylværupis**, Pl. 2, fig. 2.

Syn. *Pl. vaughani* Har., Proc. Ac. Nat. Sci. Phila., 1895, p. 57, pl. 4, fig. 8.
Pl. vaughani Har., Proc. Acad. etc., 1896, p. 475, pl. 20, fig. 9.

Harris' original description of vaughani.---"Size and general form as indicated by the figure; whorls about 11; 1, 2, 3 smooth and very small, 4 nodular, 5 nodular and with a subsutural line or band; 6, 7, 8, as 5 but also striate spirally; 9, 10 nodular costate, costæ showing a slight tendency to become oblique, mainly confined to the lower moiety of the whorls, strongly striate below, and with two noticeably large striæ on the carina, faintly striate above; body whorl with rather coarse spiral lines alternating in size from the carinal region to the end of the beak, supercarinal region faintly striate, costæ obscure; labrum striate within."

This species was described from the Lower Claiborne horizon of Texas. It is found at Smithville Bastrop Co. in moderate numbers.

The varietal name *sylværupis* is proposed for a larger and in some respects very different form from Woods bluff, Ala. Some of the differences have already been pointed out, and others may be given as follows: costæ in the typical form more obtuse especially on the upper part of the spire; supercarinal region more strongly marked in the smaller whorls and the subsutural band prominent in all except the embryonic whorls.

The varietal form is much larger, with a large body whorl (our figure is of an exceptionally narrow or slender form) and the supercarinal zone on the smaller spiral whorls is smooth and often without a subsutural band.

Locality.—ALA.: Woods bluff.

Type of variety and specimen figured.—Lea memorial collection, Acad. Nat. Sci., Phila.

Pleurotoma servatoidea, Pl. 2, figs. 3, 4.

Syn. *P. servatoidea* Ald., Bull. Am. Pal., vol. 1, p. 59, pl. 5, fig. 5, 1895.

Aldrich's original description.—Op. cit.

I feel very confident that in the end this name will be withdrawn in favor of *Pl. huppertzi* Har.; for the latter is subject to considerable variation as shown on pl. 4, Proc. Acad. Nat. Sci., 1895. This is the form referred to on page 58 of the Proceedings, where *huppertzi* was described, in the following terms. "A very closely allied form occurs at Woods bluff, Ala. The main difference consists in the different location of the retral sinus. In the Alabama specimens it is located on the humeral angle while in the Texan it is about one-third way from the angle to the suture."

Aldrich's type from Gregg's landing is a little different from the common Woods bluff specimens but is certainly identical with the same.

When well preserved, the young show a slight carination as indicated by fig. 4. Two or three rather conspicuous and distant spiral lines are located on this carinal zone.

Localities.—ALA.: Woods bluff; Gregg's landing.

Type.—Aldrich's collection.

Pleurotoma moorei, Pl. 2, fig. 5.

Syn. *Turris moorei* Gabb. Jr. Acad. Nat. Sci. Phila., vol. 4, p. 378, pl. 67, fig. 11. (Not 9.)

Pleurotoma tuomeyi Ald., Geol. Surv. Ala., Bull. 1, p. 31, pl. 3, fig. 11, 1886.

Pleurotoma tuomeyi Heilp., Proc. Acad. Nat. Sci. Phila., 1890, p. 394.

Surcula moorei Heilp., Proc. Acad. Nat. Sci. Phila., 1890, p. 394.

Pl. (*Surcula*) *moorei* Har., Proc. Acad. Nat. Sci. Phila., 1895. p. 57, pl. 4, figs. 6, 6 a, 6 b.

Gabb's original description.—"Shell elongated fusiform, whorls nine or ten, strongly carinate; mouth narrow, long, half the length of the shell, inner lip curved with a very delicate coat of enamel, so thin as to be visible only on a very well preserved specimen, outer lip thin, showing internally the marks of the larger ribs; surface marked by about twenty-five revolving lines, smaller on the shoulder of the whorl (except one large one at the upper edge, below the suture) than elsewhere; in the largest specimens, two or three of the principal ribs are compound; the rest are simple, near the apex; on the upper two of the principal revolving lines are small tubercles which disappear in the succeeding whorls

"Dimensions.—Length, 1.1 in., length of mouth, .55 in., width of body whorl 3 in."

"The fine specimen figured, is in my collection from Caldwell Co., Texas. It is nearly twice as large as any other specimen I have seen of the same species."

A discussion of the slight differences between this and the Texas Lower Claiborne species will be given in our Bulletin on that horizon.

Lignitic localities.—ALA.: Woods bluff.

Type specimen.—Probably lost. Duplicates in Phila. Acad. etc.

Specimen figured.—From' Woods bluff.; Paleont. Musuem, Cornell University.

Pleurotoma langdoni, Pl. 2, fig. 6.

Syn. *Pl. acuminata ?* Heilprin, Proc. Acad. Nat. Sci. Phila., 1880, p. 374, pl. 20, fig. 10.

Pl. langdoni Ald., Bull. Am. Pal., vol. 1, p. 60, pl. 4, fig. 5.

Pl. sp. ? Har., Bull. Am. Pal., vol. 1, p. 192, pl. 17, fig. 14.

Aldrich's description.—(See vol. 1, p. 60.)

We have already seen how in the Midway stage (vol. 1, p. 192) the forerunner of this species differs from the Lignitic or typical form by its less elevated spire, fewer and more prominent costæ, greater basal deflection of columella, etc., and we might add that the subsutural band, of but slight elevation in either form, is traversed by a spiral line in the Midway form while it is rendered crenulate in the Lignitic by the greater strength of the lines of growth as they approach the suture.

A small specimen in my own collection from Bell's landing, has more nearly the ribbing of the Lignitic form though the subsutural elevation is simple like the Midway specimen.

The Hatchetigbee specimens are remarkable for the great comparative size of the body whorl, short spire, fine and oblique costation, coarse spiral and lines of growth, and coarse beading of the subsutural elevated band. In these too it is especially noticeable that it is the lower margin of the subsutural band that is most strongly beaded.

The origin of this species and that of *P. nasuta* is clearly in the Midway *P. persa*; for among the numerous Gregg's landing specimens there are *P. nasuta* extremly close to *P. persa* and at Bell's there are specimens of *nasuta* on the high road to *langdoni.*

Lignitic localities.—ALA.: Bell's landing; Woods bluff, Hatchetigbee bluff.

Type.—Aldrich's collection, from Hatchetigbee.

Specimen figured.—Woods bluff.

Pleurotoma roscoei, n. sp., Pl. 2, fig. 7.

Specific characterization.—Whorls 8 to 10, smooth, the upper whorls very small, while the body whorl and one or two above are comparatively large, giving the sides of the spire a concave appearance; two spiral lines just beneath the suture on the last three whorls; sinus slightly above the middle; body whorl tumid, spirally striate below; labial collosity prominent.

In external markings this species resembles *P. tombigbeensis*, but in the latter the retral sinus is located higher up on each whorl and is more sharply curved.

Locality.---ALA.: Gregg's landing.

Type.—Paleontological Museum, Cornell University.

Pleurotoma exilloides, Pl. 2, fig. 8.

Syn. *P. exilloides* Ald., Bull. 1, Geol. Surv. Ala., 1886, p. 30, pl. 3, fig. 9.

Aldrich's original description.---"Shell slender; spire high; whorls ten, rounded, slightly shouldered below the suture; a rather strong impressed line just below, the fainter ones still lower.

"The first four or five whorls of the apex smooth, the others transversely striate, striations very closely set on the body whorl. Slit nearly semicircular; outer lip gently curved; columella bent; canal short, curved to the right.

Locality.—Lower bed, Woods Bluff, Ala.

"This species is close to *P. perexilis*, * * but differs in the breadth of the body whorl, and the slight shouldering of the same. The slit is larger and revolving lines much fainter."

Type and specimen figured.—Aldrich's collection.

Pleurotoma capax, Pl. 2, fig. 9.

Syn. *P. capax* Whitf., Amer. Jr. Conch., vol. 1, 1865, p. 261, pl. 27, fig. 3.

P. capax Ald., Geol. Surv. Ala., Bull 1, p. 55, 1886.

Whitfield's original description.---"Shell small, broadly fusiform; volutions five, strongly concave on the upper side, and ventricose below; ornamented on the periphery of the upper volutions with a line of nodes, which gradually decrease in size, and finally become obsolete on the body whorl; columella strong, slightly twisted in the lower part; aperture wide, and with the canal, forming more than one-half the entire length of the shell; surface marked by very fine, tortuous, revolving lines, very faint on the concave part of the volutions, crossed by fine lines of growth, having a slight curve in the upper part.

"*Dimensions.*—Length a little less than 1 inch, transverse diameter .45 inch.

"*Locality.*—Six miles above Claiborne, Ala."

Localities.—ALA.: Gregg's landing, Tuscahoma and according to Aldrich, at Bell's landing also.

Type and specimen figured.—Gregg's landing, Paleont. Mus. Cornell University.

Pleurotoma (—?) siphus, Pl. 2 fig. 10.

Syn. *F. siphus* Ald., Bull. Am. Pal., vol. 1, p. 64, pl. 4, fig. 2.
Fusus (?) *siphus* Cossmann Rev. Bibl. Annee, 1895, p. 35.

Aldrich's original description.—Op. cit.

Cossmann says of this species that it is a form "à laquelle je ne vois pas d'analogue et qui mériterait peut-être de former un nouveau sous-genre."

The curvature of the lines of growth backward just below the suture, it seems to us, is sufficiently distinct to indicate a relationship with the Pleurotomids, though the subgenus to which it should be referred is doubtful.

Locality.—ALA.: Gregg's landing.

Type.—Aldrich's collection.

Specimen figured.—Paleont. Mus., Cornell University.

Pleurotoma terebralis, var. Pl. 2, fig. 11.

Syn. *Cochlespira bella* Con., Am. Jr. Conch., vol. 1, p. 210, pl. 21, fig. 6, 1865.
Pl. (*Cochlespira*) *cristata* Heilp, Proc. Ac. Nat. Sci., Phila, 1880, p. 365.
Pleurotoma volgeri Meyer, Proc. Ac. Nat. Sci. Phila., 1884, p. 107.
P. cristata Ald., Geol. Surv. Ala., Bull. 1, p. 52, 1886.
P. terebralis Ald., *idem*, p. 55.

Lamarck first described and named this species in 1804, (Ann. Mus. vol. 3, p. 266). In his Animaux sans Vertèbres, vol. 7, p. 101, 1822, he described the species as follows:

"*Pl. testa fusiformi, subventricosa; striis transversis eleganter granulatis; anfractibus exquisite carinatis: carinis dentatis rotaeformibus.*

"*Pleurotoma terebralis* Ann: ibid. No. 20."

"Habite—Fossile de Parnes. Cabinet de M. Defrance. Longueur, près de 14 millimètres."

P. terebalis from its typical locality differs from our specimens by having a somewhat longer canal in proportion to the height of the spire, has finer striations and crenulations, and is not so bi-carinate on the body whorl. F. E. Edwards however found (Paleont. Soc. vol. XXI, p. 233, pl. XXVII, figs. 10 a—k.) that the lower Eocene of England contained many varieties of this species and to them he gave six varietal names. Deshayes says in his An. Sans. Vert., vol. 3, p. 359, 1864: "Cette belle espèce est beaucoup plus variable que nous ne nous l'étions imaginé lorsque nous l'avons décrite dans notre premier ouvrage; quelques variétés existent dans le calcaire grossier, mais les plus nombreuses et les plus singulières se montrent dans les sables inférieurs."

In both Old and New world representatives of this species the specimens from lower Lignitic horizons (Sables inferieurs) are less finely crenulate than their middle or upper Eocene posterity.

Lignitic localities.—ALA.: Gregg's landing, Woods bluff, 3 miles S. W. of Thomasville.

Specimen figured.—Paleont. Mus., Cornell University.

Pleurotoma tombigbeensis, Pl. 2, fig. 12, a.

Syn. *P. tombigbeensis* Ald., Bull. 1, Geol. Surv. Ala., 1886, p. 30, pl. 3, fig. 10.

Aldrich's original description.—"Shell large, rather thick and solid, fusiform; whorls eleven; suture impressed; the spire regularly acuminate, the upper whorls flattened; lower ones constricted below the suture.

"Body whorl constricted about the center, tapering regularly toward the beak; a large number of fine sinuous revolving lines upon this lower part.

"Aperture less than half the length of the shell; slit small, situated at the lower part of the sutural constriction, its outer edge rising up and rounded; canal moderate, open, bent a little to the right; columella with a reflected callus near the beak.

Locality.—Lower bed, Woods bluff, Ala.

"On younger specimens the constriction below the suture is obsolete, being replaced by a few faint revolving lines. Resembles *P. longiforma*, *nobis*, but in some respects differs. It is much more fusiform, heavier, the body whorl much more tapering below. The aperture gradually diminishes anteriorly, while in the first mentioned species, and in *P. gabbi* Con., the canal is long and slender."

Localities.—ALA.: Woods bluff; near the mouth of Bashi creek; Bell's landing.

Type and specimen figured.—Aldrich's collection, from Woods bluff.

Pleurotoma silicata, Pl. 2, fig. 13.

Syn. *P. silicata* Ald.. Bull. Am. Pal., vol. 1, p. 60, pl. 4, fig. 3, 1895.

Aldrich's original description.—Loc. cit.

Locality.—ALA.: Gregg's landing.

Type.—Aldrich's collection.

Specimen figured.—Paleont. Mus., Cornell University.

Surcula nasuta. Pl. 2, figs. 14, 15.

Syn. *P. nasuta* Whitf., Amer.; Jr. Conch. vol, 1, p. 262, 1865.
P. nasuta Ald., Geol. Surv. Ala. Bull. 1, p. 55, 1886.
P. nasuta Har., Proc. Ac. Nat. Sci. Phila., 1896, p. 478, pl. 22. fig. 7.

Whitfield's original description.—"Shell fusiform, much elongated and slender; spire consisting of five or six whorls; volutions concave above, subangular in the middle, and rounded below, marked on the middle by a row of longitudinally elongate nodes; entire surface marked by fine, somewhat alternating, revolving lines, less distinct on the channel formed by the notch of the aperture; suture distinct, bounded below by an elevated band; aperture narrow, elongate, and, together with the long, straight canal, forming more than one-half the length of the shell.

Locality.—Six miles above Claiborne, Ala., west side of the river."

This species is extremely variable in ornamentation, ranging in this respect nearly all the way from *persa* to *langdoni*. It is very abundant at Gregg's landing, but occurs at other places as indicated below. This is decidedly a lower Lignitic species.

No one would at first sight regard fig. 14 as belonging to this species. In fact one of my assistants had labelled it *P. persa*, and it certainly does have the appearance of that species. But by closer examination it is seen to have a rather deeper or sharper retral sinus, somewhat inclined to become carinate sub-centrally and costate. Others associated with it have much stronger costations. At Yellow bluff somewhat more *nasuta*-like forms occur; at Tuscahoma still more typical *nasuta* are found while at Gregg's landing the type form occurs in abundance.

Pleurotoma cainei, n. sp. Pl. 2, fig. 16.

Specific characterization.—Size and general form as indicated by the figure; embryonic whorls in perfect specimens about four or five in number, smooth; five post-embryonic whorls of the spire strongly marked by deeply incised spiral lines, the first one below the suture slightly stronger than the others causing a slight constriction at this place; costæ scarcely observable when the spire is pointed towards the light, but when turned sidewise the low, rounded, curved ribs are very evident; from the suture they pass upwards and to the right till a point just above the middle of the whorl is reached and there bend rather sharply to the left, becoming less strong and then pass upwards to the suture, forming a slight enlargement at that place; body whorl with humeral region marked by ribs as described above, dying out below, and by strong spiral lines.

Closely allied to *P. variata* Edw. and *P. koninckii* Nyst, from the London clay. Costation somewhat as in *hœninghausii* Lea.

Localities.—ALA.: Woods bluff; 3 miles S. W. of Thomasville.

Type.—Paleontological Musuem, Cornell Univ.

Pleurotoma georgei, n. sp., Pl. 2, fig. 17.

Specific characterization.--Size and general form as indicated by the figure; whorls 7 or 8; 1, 2 and sometimes 3 smooth; 3 or 4 obliquely ribbed longitudinally; 4 to 7 or 5 to 8 with ten or eleven nearly vertical (more oblique on the body whorl) costæ, extending from suture to suture, somewhat carinated centrally, crossed on the shoulder by about six fine spiral striæ and three or four strong raised lines below the middle of the whorl; columella very obliquely striate below.

I have tried in vain to refer this to the young of some larger form. The broad retral sinus on the humeral zone distinguishes this species at once from the preceding.

Locality.—ALA.: Woods bluff.

Type.—Paleontological Museum, Cornell Univ.

Pleurotoma carlottæ, n. sp., Pl. 3, fig. 1.

Specific characterization.—Size and general form as indicated by the figure; whorls about 10; 1, 2 and 3 smooth, increasing rapidly in size, 4 and 5 longitudinally costate, 6–9 marked by (a) a rather prominent subsutural raised broad line, (b) numerous costæ very prominent on the middle of the whorls but faint above and below, crossed on the humeral region by a faint spiral line and on the carinal by two stronger spirals, and by a fourth spiral half way from carina to suture below; 10, or body whorl, marked as 6–9 but having the subsutural band sometimes furrowed by a medial spiral line and more or less crenulated by many rather deep transverse lines; raised spirals alternating and decreasing in strength towards the base.

Localities.—ALA.: Woods bluff; 3 mi. S. W. of Thomasville.

Type and specimen figured.—Woods bluff: Paleontological Museum, Cornell Univ.

Pleurotomella sigma, n. sp., Pl. 3, fig. 2.

Specific characterization.—Size and general form as shown by the figure; whorls about seven; (apex?); marked by about fourteen rather prominent costæ, vertical and of about the breadth of the interspaces above, but becoming more oblique and of about one-half the breadth of the interspaces below, especially on the body whorl; a slightly elevated band just below the suture; surface covered with evenly set, alternating coarse and fine lines.

This is intermediate in many respects to *P. whitfieldi* Ald., and *P. bellistriata* Clark.

Locality.—ALA.: Woods bluff.

Type and specimen figured.—Paleont. Mus. Cornell Univ.

Pleurotoma (Mangilia) infans, Pl 3, fig. 3.

Syn. ? *Scobinella læviplicata* Gabb, Jr. Acad. Nat. Sci. Phila., vol. 4, p. 380, pl. 67, fig. 20, 1860.

Pleurotoma infans Meyer, Geol. Surv. Ala., Bull. 1, p. 75, pl. 2, fig. 9, 1886.

Scobinella infans Cossm., Ann. de Geol. et Pal., p. 43, 1893.

Pl. infans Har., Proc. Ac. Nat. Sci. Phila., 1895, p. 62, pl. 5, fig. 10.

Glyphostoma harrisi Ald., Bull. Am. Pal., vol. 1, p. 61, pl. 2, fig. 11, 1895.

Meyer's original description.—"Small; aperture and canal about one-third of the entire length; the pointed apex is formed by two and a half small, smooth, embryonic whorls; three rather large transversely ribbed, embryonic whorls complete the nucleus; the largest specimen has three adult whorls,—they are strongly carinated in the middle; the upper part has only one revolving line near the suture, the lower part three elevated spirals; the upper part indicates the position of the large, regularly rounded sinus; the lines of the growth are almost rib-like.

Localities.—Red bluff, Miss., Newton, Miss., Claiborne? Ala., Vicksburg, Miss. (var)."

Meyer's specimens are evidently all young or imperfect, for in the well grown examples from Texas there are four adult whorls. Moreover, they show two large tooth-like projections on the inside of the labrum and not unfrequently two small plaits on the columella. On the smooth sinus zone there is sometimes a fine spiral line; occasionally there are two.

The Lignitic specimens show one, rarely two large spiral lines or carinæ on the medial and upper whorls. None so far as noticed show signs of labral or labial dentition.

Lignitic locality.—ALA.: Woods bluff.

Its range is now extended from the Lignitic to Oligocene inclusive.

Type.—Red bluff, Miss.; Aldrich collection.

Specimen figured.—Woods bluff; Paleont. Mus. Cornell Univ.

Pleurotoma veatchi, n. sp., Pl. 3, fig. 4.

Specific characterization.—Shell long fusiform; when complete and unworn, with five smooth embryonic whorls, then one more or less vertically ribbed,and finally about three spiral whorls; the latter with spiral alternate lines and curving humeral costal folds, dying out towards the suture and below the shoulder, almost obsolete on the body whorl. Mouth fully as long as the spire; columella long, straight.

Locality.—ALA.: Woods bluff.

Type and specimen figured.—Lea Memorial collection, Acad. Nat. Sci. Phila.

CANCELLARIA.

Cancellaria sylværupis, Pl. 3, fig. 5.

Syn. *C. sylværupis* Har., Proc. Ac. Nat. Sci. Phila., 1896, p. 476, pl. 20, fig. 11,

Harris' original description.—"General form and size as indicated by the figure; whorls about 6; 3 embryonic smooth; others with about 8 strong spiral lines between the suture above and the suture below; incremental lines especially prominent between the strong raised spirals; labrum sharp at edge but abruptly thickening and varicose a slight distance within; columella concave, two plaits on its subcentral portion and one marginal one below.

This species reminds one of *C. quadrata* of England and *C. ulmula* from Texas."

Locality.—ALA.: Woods bluff.

Type and specimen figured.—Lea Memorial collection, Acad. Nat. Sci. Phila.

Cancellaria quercollis, var. **greggi**, nov. var., Pl. 3, fig. 6.

Syn. *Volutilithes quercollis* Har., Bull. Am. Pal., vol. 1, p. 199, pl. 18, fig. 4.

Varietal characterization.—Costæ on body whorl about 20 instead of 15; 4 or 5 revolving lines or bands present on each spiral whorl with interspaces marked by three thread-like raised lines, the middle one the largest.

So extremely different is this spiral ornamentation from that of the specimen I formerly referred to a form of *Volutilithes*, a Midway type, that it is perhaps hazardous to refer this to the same species. But the peculiar, oblique costation, nonconformable to the lines of the growth, the smooth apical whorls, the fact that the lower part of the columella and body whorls of *quercollis* were gone and hence the generic position was not certain, all tend to suggest a probable relationship between these very different looking forms.

Localities.—ALA.: Gregg's and Bell's landings.

Specimen figured. Paleont. Mus., Cornell Univ.

Concellaria tortiplica, Pl. 3, fig. 7.

Syn. *C. tortiplica* Con., Am. Jr. Conch., vol. 1, p. 145, 1865; p. 211, pl. 20, fig. 8. (Not pl. 21 as stated by Conrad).
C. evulsa Heilp., Proc. Ac. Nat. Sci. Phila., 1880, p. 365.
C. tortiplica Har., Proc. Ac. Nat. Sci. Phila., 1896, p. 475, pl. 20, fig. 10.

Conrad's original description.—"Subfusiform, with longitudinal narrow ribs and a few thick varices; volutions six, those of the spire convex; regular, prominent revolving lines, six in number, on the penultimate volution, eighteen or nineteen on the body whorl, fine, and crowded near the suture and base; labrum striate within; columella with three sinuous plaits, the upper one large and thick.

"Length ⅜ inch."

"*Locality.*—Texas.

In my Phila. Acad. paper (see above), I gave Conrad's incorrect reference to his plate and figure, i.e.: I wrote fig. 8, pl. 21, when I should have written fig. 8, pl. 20. Conrad's pl. 21, fig. 8 represents *Cancellaria ellapsa*, a Cretaceous, Texan, species with no columellar plications. It is doubtless the same as *Trichotropis cancellaria.*

C. tortiplica shows at Woods bluff great variations, both as regards form and general outline. As a rule the body whorl is larger in proportion to the whole shell than the figure would lead one to suppose. This is particularly true of the Texan specimens. The two anterior plicæ are apt to be more or less united at base, or in other words are both superimposed on a common fold.

Localities.—Alabama: Woods bluff ; Choctaw corner.

Type.—From Texas, according to Conrad; Museum Acad. Nat. Sci., Phila.

Cancellaria lanceolata, Pl. 3, fig. 8.

Syn. *C. lanceolata* Ald., Nautilus, vol. 11, p. 27, (fig.), 1897.

"Shell elongated, whorls seven, first three nuclear and smooth, the others cancellated and having three strong revolving lines, the middle one much the larger, the costæ numerous and fine. Whorls are shouldered, suture deeply marked; body whorl with seven or eight revolving raised lines. Aperture oblong, outer lip serrated by the raised lines, nearly smooth within. Columella lip without callus, bearing two or more folds, part of the raised lines passing into the aperture to form them; canal short, oblique, slightly twisted; no umbilicus. Length 7½ mm., diam. 3¾ mm.

"*Locality.*—ALA.: Choctaw corner , Woods bluff horizon.

"This little shell has some resemblance to *C. pulcherrima* H. C. Lea, but Mr. C. W. Johnson, of the Wagner Free Institute of Science, has compared the two and finds the above distinct. The specimens are not fully matured. One of the two specimens has been presented to the 'Lea Collection,' in the Academy of Natural Sciences of Philadelphia."

This is evidently a young specimen of the same species shown by pl. 3, fig. 8. It might now be characterized as follows:—Whorls about 10: 1–3 smooth; remaining whorls with two stron carinal raised bands or ridges and sometimes a third just above th suture; sharply defined raised axial lines extend from the sutur backward obliquely and outward to the upper carina, pass ove the same and extend more nearly vertically to the lower carina, thence obliquely to the left to the suture below; on the body whorl the direction again changes to obliquely to the right; umbilicus rather rudimentary; columellar plaits as follows: anteriorly a rather indistinct, nearly vertical slight fold on the columella, above and to the left of which is a slight groove and above this a plait, very obliquely set, and well separated from the next above or posterior by a deep groove, this groove widening and extending into the umbilicus; large posterior plait transversely set within but curving down into the umbilicus without; strong spiral ridges often form plait-like projections posterior to the above mentioned plaits. This species is closely allied to *Cancellaria maglorii* as figured by Deshayes, Desc. An. Sans Vert., vol. 2, pl. LXXII, figs. 18, 19, 1864.

Locality.—ALA.: Woods bluff; Choctaw corner.

Type.—Aldrich's collection.

Specimen figured.—Pl. 3, fig. 8. Paleont. Mus., Cornell Univ.

Cancellaria marieana, Pl. 3, fig. 9.

C. marieana Ald., Bull. Am. Pal., vol. 2, p. 179, pl. 2, fig. 6, 1897.

Aldrich's original description.—Op. cit.

We have several good specimens of this species from Woods bluff, one of which shows a slight carination as indicated by the figure. Others, however, are without any trace of such a feature. The comparatively straight columnella and especially the columellar plication and the umbilicus serve to distinguish them at once from the young of *C. tortiplica.*

Localities.—ALA.: Woods bluff: (Choctaw corner, Aldrich.)

Type and specimen figured.—Aldrich's collection; from Choctaw corner.

Cancellaria graciloides, Pl. 3, fig. 11.

Syn. *C. graciloides*, Ald., The Nautilus, vol. 11, p. 98, 1898.

Aldrich's original description.—Shell broadly fusiform, spire elevated, whorls 6-7, rounded, slightly shouldered, cancellated, first three smooth, on the others the revolving lines are numerous, strongly defined; lines of growth smaller and much finer than the revolving lines, suture deeply impressed, outer lip expanded, strongly nodular within, columella with three folds, aperture pointed and canaliculate at base.

"Height 12 mm., width 7 mm.

"*Locality.*—Gregg's landing; Alabama river, Alabama."

Cancellaria graciloides var. **bella,** nov. var., Pl. 3, fig. 10.

"Characterized by strong, rounded varices, as many as three on the body whorl. Shell is smaller than the type.

"Height 10 mm., width 6 mm.

"*Locality.*—Gregg's landing, Alabama river, Alabama."

Many specimens from this locality show that the variety could more properly have been called the species, and that the specimen called the type of the species could have been referred to a variety of the same. In other words, var. *bella* is the common, abundant, well defined form, while *graciloides* is very rare.

Mr. Aldrich has very kindly furnished the figures herewith given and has lent me the type specimens for study. On our largest specimens the lines of growth at their intersection with the revolving bands or heavy lines form slight nodes or tubercles.

Localities.—Alabama: Gregg's landing; Bell's landing.

Types and specimens figured.—Aldrich's collection.

Olivella mediavia, Pl. 3, fig. 12.

Syn. *V. bombilis*, var, Ald., Geol. Surv. Ala., Bull. 1, p. 53, 1886.
O. gracilis Ald., Geol. Surv. Ala., Bull. 1, p. 56, 1886.
O. mediavia Har., Bull. Am. Pal., vol. 1., p. 194, pl. 17, fig. 19.

Harris' original description.—(*Loc. cit.*)

Lignitic specimens are sometimes nearly twice the size of the Midway prototypes. They do not as a rule show the geniculation in the growth lines on the lower portion of the body whorl so plainly as do the Midway specimens. A labial callosity near the posterior portion of the aperture is often quite evident. The extent to which the spire is callosed over varies considerably in different specimens; generally there is an exceedingly narrow band of shell showing lines of growth just below the suture.

Lignitic localities.—ALA.: Bell's landing; Woods bluff.

Specimen figured.—Woods bluff; Paleontological Museum, Cornell Univ.

Ancilla (Olivula) staminea, Pl. 3, fig. 13.

Syn. *A. staminea* Con., Foss. Sh. Tert. Form., p. 25. pl. 10, fig. 5.
Anaulax staminea Con., Proc. Ac. Nat. Sci., Phila., 1857, p. 166.
A. staminea Ald., Geol. Surv. Ala., Bull. 1, p. 51, 1886.

Conrad's original description.—"Cylindrical, with strong longitudinal lines and minute revolving wrinkled striæ; a slight elevation crowns the whorls, defined by a separating line; spire very short, apex rather obtuse; suture distinct; inferior portion of the columella with an elevated profoundly striated callus, above which are three or four lines revolving to the base; aperture gradually contracted above and effuse at the base.

Locality.—ALA., Claiborne, Middle Tertiary.

"Of the species described by Lamarck, this shell approaches nearest *A. canalifera*. These two species do not correspond entirely with the genus *Ancillaria*, as the aperture is much longer, the shells are striated, and the suture is somewhat channeled. They might constitute a separate genus by the name of OLIVULA, and would connect *Ancillaria* with *Oliva*."

The Lignitic form of this species differs considerably from the typical Claibornian; it is smaller, heavier, smoother, and with much higher spire. Specimens from the Lower Claiborne beds at Smithville, Texas, have the high spire of the Lignitic specimens, but in other respects approach closely, except in size, the typical forms.

Locality.—ALA.: Woods bluff.

Specimen figured.—Paleontological Mus., Cornell Univ.

Buccinanops ellipticum, Pl. 3, figs. 14, 15.

Syn. *Pseudoliva elliptica* Whitf., Am. Jr. Conch., vol. 1, p. 260.
Pseudoliva elliptica Ald., Jr. Cinn. Soc. Nat. Hist., July, 1897, p. 80.

Whitfield's original description.—"Shell small, broadly elliptical; spire produced above, pointed; volutions, four or five, rounded on the sides, the largest slightly inflated; suture close, bounded by a narrow band below; columella a little twisted, and flattened in the lower part; aperture wide, a little more than half the length of the shell, pointed above and deeply notched at the base; a very faint revolving grove at the top of the anterior third of the body volution, marking the place of the very small tooth-like projection on the outer lip; surface smooth, except a rather broad band near the base of the last volution formed by the siphonal notch."

"*Dimensions.*—Length, ¾ inch, transverse diameter ⅜ inch."

"*Locality.*—Vicksburg, Miss."

Aldrich (loc. cit.) says: "The locality given by Whitfield is no doubt incorrect. The shell is described from a single specimen. An examination of the contents of the interior of the type showed a light colored sand exactly similar to that in my specimens collected from Bell's landing, Alabama, on the Alabama river. The type is a half grown form.

Personally I have not been able to see Whitfield's Alabama types, but I have no doubt Aldrich is right in the foregoing statement. If so, then in all probability it is the form I have figured, especially common at Yellow bluff, that should be referred to this species. This may be, and probably is the Lignitic representative of *Buccinanops altile*, but for the present the two will be kept separate.

Localities.—Ala.: Bell's landing ? and Yellow bluff.

Type.—Hall's collection.

Specimen figured.—Paleont. Mus., Cornell Univ.

Pseudoliva vetusta. Pl. 3, fig. 16.

Syn. See Bull. Am. Pal., vol. 1, p. 213.

The Lignitic specimens are apt to have an enormous callosity of the inner lip, especially posteriorly. The latter volutions are kept out away from those just preceding by this callosity. In the same way, *Volutilithes petrosus* is distorted, forming an apparently distinct species called *V. tuomeyi.* The great variation of this species at different stages of growth and under dissimilar circumstances has caused many names to be given as specific, when if given at all they should have been employed to designate the varieties only. See our bulletin on the Lower Claiborne stage.

Lignitic localities.—ALA.: Bell's landing; Yellow bluff; near mouth of Bashi creek; 4 mi. above Hamilton bluff; Hatchetigbee; Nanafalia; Tuscahoma.

Specimen figured.—Lea Memorial collection, Acad. Nat. Sci., Phila.

Pseudoliva tuberculifera, Pl. 3, fig. 17.

Syn. *P. tuberculifera* Con., Jour. Acad. Nat. Sci., Phila., vol. 4, p. 294, pl. 47, fig. 27, 1860.

Conrad's original description.—"Short-fusiform, with well defined revolving lines; angle of body whorl with compressed tubercles; whorls of spire longitudinally ribbed, the penultimate whorl distinctly ribbed; above the angle of the body whorl the area is slightly concave and tumid or salient above; umbilicus none. Length 1 inch; diameter ⅝ inch.

Cossmann's *P. tuberculifera* Ann. de Géol. et de Paléont., 1893, p. 2, fig. 13, is without doubt the young of *P. vetusta*.

Localities.—ALA.: Bell's landing. MD.: South river, north bank, at mouth of Beaver creek.

Type.—Acad. Nat. Sci., Phila. (Not from Claiborne as the label reads.)

Specimen figured.—Paleontological Musuem, Cornell Univ.

Pseudoliva scalina, Pl. 3, fig. 18.

Syn. *P. scalina* Heilp., Proc. Ac. Nat. Sci., Phila., 1880, p. 371., pl. 20, fig. 12.
P. scalina Ald., Geol. Surv. Ala., Bull. 1, p. 20, pl. 6, fig. 10.

Heilprin's original description.—"Shell bucciniform, of about seven volutions; the whorls roughly plicated; the folds on the body whorl appearing as shoulder nodules; dentiferous sulcus well pronounced, followed by about five impressed revolving lines, which slightly crenulate the margin of the outer lip; revolving lines on the body whorl above the sulcus almost obsolete; aperture slightly exceeding the spire in length; columella callous; suture deeply channeled. Length, 1½ inch. Woods bluff, Clark Co., Ala."

Aldrich has very kindly lent us the large fine specimen shown about ½ natural size by fig. 18.

Localities.—Alabama: Bell's landing; Nanafalia; Woods bluff.

Type.—From Wood's bluff; Cabinet Ala. Univ., Tuscaloosa, Ala.

Specimen figured.—Bell's landing: Aldrich's collection.

Volutilithes petrosus, Pl. 4, fig. 1.

Syn. *Voluta petrosa* Con., Foss. Sh. Tert. Form., p. 29, Aug., 1833; p. 41, pl. 16, fig. 2, 1835.
" *vanuxemi* Lea, Cont. to Geol., p. 173, pl. 6, fig. 182, Dec. 1833.
" *parva* Lea. *ibid*, p. 173, pl. 6, fig. 181.
Athleta tuomeyi Con., Proc. Ac. Nat. Sci. Phila., 1853, p. 449.
Voluta tuomeyi Tuomey, 2d Bien. Rept. Geol. Ala., p. 270.
" *petrosa* Tuomey, 2d Bien. Rept. Geol. Ala., p. 272.
Volutilithes (*Athleta*) *tuomeyi* Con., Jr. Acad. Nat. Sci. Phila., vol. 4, pl. 47, fig. 35, 1860.
" (*Athleta*) *tuomeyi* Con., Am. Jr. Conch., vol. 1, p. 24, 1865.
" *symmetricus* Con., Wailes' Agr. Miss., 1854, pl. 15, fig. 6; Proc. Ac. Nat. Sci. Phila., 1865, p. 260.
" *dumosus* Con., Wailes' Agr. Miss., 1854, pl. 16, fig. 1.
" *indenta* Con.. Am. Jr. Conch. vol, 1, p. 144, p. 211, pl, 21, fig. 10.
" *impressa* Con., Am. Pr. Conch., vol. 1, p. 144, p. 211, pl. 20, fig. 3.
" (*Athleta*) *tuomeyi*, Heilp., Proc. Acad. Nat. Sci. Phila., 1880, p. 365.
Voluta Athleta tuomeyi Ald., Geol. Surv. Ala., Bull. 1, pp. 58, 55, 52, 50.
Volutilithes petrosus Dall, Tr. Wag. Fr. Inst. Sci., vol. 3, p. 75, 1890.
? " *precursor* Dall, Tr. Wag. Fr. Inst. Sci., vol. 3, p. 84, pl. 6, fig. 1, 1890.
" *Athleta tuomeyi* Clark, U. S. G. S. Bull. 141, p. 65, pl. 10, fig. 1, 6.
? *Volutilithes lisbonensis* Ald., Bull. Am. Pal., vol. 2, p. 180, pl. 3, fig. 1, a, 1897.

Conrad's original description.– "Shell subglabrous; body whorl marked with from eight to ten longitudinal folds terminating on the shoulder in compressed subacute tubercles, which are also distinct on the spire; transversely striated at base; two folds on the columella. Length, 1½ inches.

"*Locality*. Claiborne, Alabama."

Several hundred specimens of this species ranging from Lignitic to Jackson harizons inclusive, in the collection at the Smithsonian Institution were studied by the writer on several occasions in preparing certain reports on Eocene fossils. Conrad's *Athleta tuomeyi* represents only an exaggerated case of sutural and labial callosity. Dall agreed to this view of the matter and so arranged his synonyms, (Tr. Wag. Fr. Inst. Sci., vol. 3). *Pseudoliva vetusta* is similarly diseased by Lignitic conditions. *Venericardia planicosta* is also excessively thickened under similar conditions.

Of the recently named *V. precursor* and *V. lisbonensis* it may be said that they are of doubtful validity. Dall was mistaken in supposing that his *V. precursor* was associated with *V. rugatus*, a Midway species. It is in reality associated with *V. petrosus* in the Lower Claiborne beds of Texas and is separated from the latter with the greatest difficulty. Aldrich's *V. lisbonensis* is one of the many connecting forms. Next year we shall have occasion to give figures of the other intermediate varieties.

Lignitic localities.—Texas: Sabinetown. Alabama: Nanafalia; Tuscahoma; mouth of Bashi creek; Woods bluff; Hatchetigbee bluff; Yellow bluff; Gregg's landing; Bell's landing.

Choctaw creek, Bethel, 4 mi. S. Mt. Sterling, Hatchetigbee, Hendrick's marl bed, Butler. Aldrich.

Type.—Acad. Nat. Sci. Phila. Heilpin has improperly added "Claiborne, Alabama," on Conrad's original label.

Specimen figured.—From Woods bluff. Paleontological Mus., Cornell University.

Voluta claræ, n. sp., Pl. 4, fig. 2.

Specific characterization. Size and form as indicated by the figure; whorls marked by 8 or 9 costæ, more or less continuous from one whorl to the other; body whorl marked by costæ having a tendency to become somewhat shouldered and spine bearing; just below the suture are traces of fine spiral lines; they reappear near the base of the shell; otherwise surface smooth, shining; columellar plications eight in number, ultimate anterior small, penultimate large and strong, third smaller, fourth-eighth almost linear.

Localities.—Alabama : Hatchetigbee bluff ; Woods bluff.

Type and specimen figured.—Hatchetigbee ; Paleontological Museum, Cornell University.

Voluta, sp., Pl. 4, fig. 3.

This fragmentary specimen was found at Yellow bluff. It is the only *Voluta* we have presenting the plication features as shown in the figure. The costation is continued to a slight extent even on the body whorl. It is just possible however that this is but an aberrant form of *V. newcombiana*, though it is more probably an ancestral type of *Lapparia pactilis*.

Voluta newcombiana, Pl. 4, figs. 4, 4 a.

Syn. *V. newcombiana* Whitf., Am. Jour. Conch., vol. 1, p. 263, pl. 27, fig. 12.
" " Ald., Geol. Surv. Ala., Bull. 1, pp. 55, 58, 1886.
" " Ald., Jr. Cinn. Soc. Nat. Hist., 1887, p. 81.
" " Dall, Tr. Wag. Fr. Inst. Sci., vol. 3, p. 69, 1890.

Whitfield's original description.—"Shell strong and robust ; volutions six or more, moderately convex in the younger stages of growth, becoming more ventricose, and finally angular in the upper part of the body whorl ; suture distinct ; aperture about four times as long as wide, angular above, and deeply notched at the base, forming more than one-half the length of the shell ; columellar folds four, very strong, the upper one transverse, the lower ones more oblique ; outer lip thick and smooth ; surface marked only by distinct lines of growth.

"*Dimensions.*—Length 3½ inches, diameter 1⅝ inches.

"*Locality.*—Six miles above Claiborne, Alabama."

By this Whitfield doubtless meant Bell's landing. Aldrich states in 1887 that it is found only at this locality, while in 1886 he gives Nanafalia as well. It is not rare at Yellow bluff.

Type.—Hall's collection.

Specimen figured.—Paleont. Mus., Cornell University.

Scaphella heilprini, Pl. 4, fig. 5.

Syn. *Turbinella* (*Caricella*) *bandoni* Heilp. (mistake for *baudoni*). Proc. Ac. Nat. Sci. Phila., 1880, p. 373, pl. 20, fig. 15.
Turbinella (*Caricella*) *bandoni* Ald., Geol. Surv. Ala., Bull. 1, p. 51.
Scaphella (*Caricella*) *heilprini* Trans. Wag. Fr. Inst. Sci., vol. 3, p. 88, 1890.

This species has never been described, but was referred to by Heilprin as follows: "The large species of *Caricella* from Knight's branch agrees so closely with the figures of *Voluta baudoni* Desh. (Animaux sans Vertèbres, Bassin de Paris, 11, pl. 102, figs. 13 and 14), from the Paris basin, that I do not feel justified in considering it a distinct species. The American form appears to have been somewhat more elevated, but this is probably no more than a varietal circumstance.

"Length, 4 inches. Knight's branch, Clark Co., Alabama.

Dall says very properly "that the *Voluta baudoni* of Deshayes, to which this species was referred in 1880 by Prof. Heilprin, is not likely to be a *Caricella* or nearly related to the present species."

Localities.—Alabama: Woods bluff. Knight's branch, according to Heilprin. Four miles south of Mt. Sterling.—Aldrich.

Type.—Probably Ac. Nat. Sci. Phila.

Specimen figured.—Woods bluff; Paleont. Mus., Cornell University.

Scaphella demissa, var., Pl. 4, figs. 6, 7.

Syn. *Caricella demissa* Con., Proc. Ac. Nat. Sci. Phila. 1847, p. 289; Journal &c., p. 120, pl. 12, fig. 5.

Conrad's original description.—"Subfusiform; whorls six, convex, one or two whorls near the apex distinctly striated longitudinally, and with minute revolving lines; upper part of the whorls slightly concave; apex papillated, first and second volutions smooth, entire; beak striated; aperture about two-thirds the length of the shell; columella 4-plaited. Length, 1⅔ inches."

Described from the Oligocene of Vicksburg, Miss.

The specimens in question differ considerably from typical *demissa* in the proportional lengths of the spire and mouth. Moreover it is only the second whorl from the apex which is costated, the others are smooth save for the very fine microscopic spiral lines.

Each whorl is tightly appressed to the preceding, hence there is no trace of a shoulder. In *S. heilprini* there is a very slight trace of a shoulder at the suture. The latter species has no costation on its apical whorls.

Gabb described another variety of this type of *Caricella* under the name of *Cymbiola texana*, from the Lower Claiborne of Wheelock, Texas.

Locality.—Alabama : Gregg's landing.

Specimens figured.—Paleont. Mus., Cornell Univ.

Caricella podagrina, Pl. 4, fig. 8.

Syn. *Turbinella pyruloides* Ald., Geol. Surv. Ala., Bull. 1, p. 56, 1886.
C. podagrina Dall, Trans. Wag. Free Inst. Sci., vol. 3, p. 86, 1890.
" " Dall, *ibid*, p. 228, pl. 20, fig. 9, 1893.
" " Harris, Proc. Ac. Nat. Sci. Phila., 1896, p. 479, pl. 23, fig. 2.

Dall's original description.—"*C. podagrina* differs from *C. pyruloides*, and especially from *C. subangulata* (under which name I have received it from Mr. Aldrich), by its much more sunken spire, the tops of the whorls being flat or excavated ; by the last whorl with a marked but not sharp angulation at the shoulder, and wider anteriorly ; and by the sutural edge of the last whorl, which is elevated and rounded, dropping suddenly to the suture instead of being smoothly appressed against it. Wailes' figure does not show the suture of *subangulata* accurately. *C. podagrina* is also larger, much more solid and heavy, with a less polished surface, and belongs to a much earlier geological horizon.

"The nucleus is large and blunt, followed by about four whorls, which are spirally striated and show well-marked incremental lines. Between the angle and the sutural sinus, which last is emphasized, the lip is somewhat concave. In front of the angle it is nearly straight. There are four strong columellar plaits. There are no traces of color on the outside of the shell, but the middle layer of the shell, when exposed by erosion, is of a very dark color, when well preserved. In full-grown specimens there is a rather thick callus on the body whorl. The species reaches a size of 90 x 70 mm. The plaits are rather thicker and closer together than in *C. subangulata* of the same size."

Locality.—Alabama: Bell's landing.

Lapparia dumosa, Con. var.,

Aldrich cites this species (*Mitra dumosa*, var.) from Hatchetigbee bluff, (Geol. Surv. Ala., Bull. 1, p. 50), but we did not find the species there.

Dall says *Lapparia* extends from "early to later Eocene," (Trans. Wag. Inst. vol. 3, p. 79,) but I am inclined to think that if any specimens are labeled in the U. S. Nat. Museum as coming from Midway or lower Lignitic localities it is owing to confusion of labels in the collection, by L. C. Johnson.

Conomitra tracyi, n. sp., Pl. 4, fig. 9.

Specific characterization.—Size and form as indicated by the figure; whorls about 7; 1 and 2 smooth; 3 longitudinally costate; remaining whorls marked by rather small, sharp costæ extending from the suture below to the humeral angle, a depressed subsutural slope ornamented just below the suture with a reappearance of the costæ seen below; body whorl with more or less sharply defined spirals; aperture showing four transverse columellar plaits, the most anterior often very faint, the medial two strong; labrum crenate within.

If one had the spire alone of this species it could scarcely be told from the smaller whorls of *Volutilithes petrosus* and so it doubtless has been regarded, for it is quite common at Woods bluff and would doubtless have been described before now had it not had so deceitful surface ornamentation. The young of *Volutilithes* however have much longer anterior canals, the columella is arcuate and there are but two well marked plicæ on it and they are oblique, the anterior the stronger.

Localities.—Alabama: Woods bluff; 3 miles southwest of Thomasville, near Choctaw corner.

Type and specimen figured.—Near Choctaw corner; Paleont. Mus., Cornell University.

Mitra pergracilis, Pl. 4, fig. 10.

Syn. *Fasciolaria pergracilis* Ald., Geol. Surv. Ala., Bull. 1, p. 22, pl. 5, fig. 18, 1886.

Aldrich's original description.—"Shell narrowly fusiform; spire very slender; suture impressed; whorls thirteen, nucleus composed of three smooth ones, the following seven are longitudinally ribbed, balance nearly smooth; two equi-distant revolving grooves, (the one nearest the suture the largest) border it throughout.

"Canal long, spirally striated; outer lip smooth; columella bearing posteriorly three faint oblique plaits far within the aperture.

"*Locality.*—Gregg's landing, Alabama." Also, according to Aldrich p. 56, at Bell's, Lower Peach Tree and Tuscahoma.

The plaits are very small indeed and are generally but two in number. The plaits are not located sufficiently anteriorly to indicate affinities with the genus *Fasciolaria.* Nor are the plaits like those of typical *Mitra*, yet the general ornamentation and shell structure indicate a close relationship with the Mitræ. Cossmann has strangely enough confounded this with *Exilia pergracilis* with which it has no relation.

Type.—Aldrich's collection.

Specimen figured.—Gregg's landing, Alabama; Paleont. Museum, Cornell University.

Mitra hatchetigbeensis, Pl. 3, fig. 11.

Syn. *M. hatchetigbeensis* Ald., Bull. 1, Geol. Surv. Ala., p. 28, pl. 6, fig. 3, 1886.

Aldrich's original description.—"Narrow fusiform; whorls about ten; suture impressed; nucleus smooth; upper whorls longitudinally ribbed, carinate at their center and tuberculated;

the body whorl slightly concave above, with transverse tubercles; whole surface covered with fine revolving lines.

"Aperture narrow, nearly half the length of the shell; outer lip smooth; columella straight, with three nearly equal, oblique plaits.

"*Locality.*—Hatchetigbee bluff, Alabama."

Our figure shows a few additional specific characters.

Localities.—Alabama: Hatchetigbee bluff; 4 miles above Hamilton bluff, Alabama river.

Type.—Aldrich's collection.

Specimen figured.—Hatchetigbee bluff; Paleont. Museum, Cornell University.

Fusus ? whitfieldi, Ald.

Aldrich cites this species from Gregg's as well as Matthews' landing. We have not found it at the former locality, though it is by no means rare at the latter, (See *Pleurotomella whitfieldi*, Bull. Am. Pal. vol. 1, p. 190, pl. 17, fig. 8.)

Fusus interstriatus, Pl. 5. figs. 1, 2.

Syn. *F. interstriatus* Proc. Ac. Nat. Sci. Phila., 1880. p. 372, pl. 20, fig. 11.
F. tombigbeensis Ald., Geol. Surv. Ala., Bull. 1, p. 22, pl. 5, fig. 7, 1886.

Heilprin's original description.—"Shell fusiform, slender, composed of about ten convex volutions, the first three of which are smooth; whorls ornamented with both longitudinal plications and revolving lines, the last of which (about eight in the upper whorls), alternate with finer intermediate striæ; the longitudinal plications distinct on the earlier whorls, but becoming much less so on the body whorl, and the one preceding; aperture about the length of the spire; the canal somewhat tortuous; outer lip thin, dentate within.

"Length, 2 inches. Knight's branch; Cave branch, Clark Co., Alabama."

The surface ornamentation of this species varies considerably.

There is however no way of distinguishing the form represented by fig. 1 and that by fig. 2, they pass from one to the other with imperceptible gradations. The specimen Aldrich called *F. tombigbeensis* is of the rugose type and has a tendency to present crenules or nodules at the intersection of the spiral and longitudinal lines. This feature however, in a large quantity of material, is found to be not of specific value. Aldrich remarks: "The type specimen has unfortunately lost its canal, but a younger specimen supplied the description. Younger specimens have the whorls more carinated than in the figured type." Unfortunately the "younger specimen" referred to is a *Pleurotoma* (pl. 2, fig. 4). The young of this *Fusus* are not particularly carinate.

Localities.—Alabama: Woods bluff; Choctaw corner; Ozark. 4 miles south of Mt. Sterling.—Aldrich. Knight's branch, Cave branch.—Heilprin.

Type—Supposed to be in Acad. Nat. Sci. Phila.

Specimens figured.—Woods bluff; Paleont. Museum, Cornell University.

Fusus bellanus Pl. 5, fig. 3.

Syn. *F. bellanus* Har., Proc. Acad. Nat. Sci. Phila., 1897, p. 479, pl. 23, fig. 3.

Harris' original description.—"Size and general form of the shell as indicated by the figure; whorls 8 or 9; embryonic 3 smooth; others marked by from 8 to 10 sharp, flattened peripheral spines, at whose base, or immediately at the suture, a subordinate series of spines occurs on the larger whorls; canal nearly closed, long, straight; labial callus thin. At first sight this seemed like a large, well-formed *F. mohri*, but on comparing details it was found to be very distinct."

Locality.—Alabama; Bell's landing.

Type and specimen figured.—Lea Memorial collection, Acad. Nat. Sci. Phila.

Fusus subtenuis, Pl. 5, fig. 4.

Syn. *F. subtenuis* Heilp., Proc. Ac. Nat. Sci. Phila., 1880, p, 371, pl. 20. fig. 4.
F. subtenuis Ald., Geol. Surv. Ala., Bull. 1, pp. 52, 55, 1886.

Heilprin's original description.—"Shell fusiform, of about seven sub-angular volutions: whorls ornamented by somewhat obscure longitudinal folds, about twelve on the body whorl, which are cut by several prominent revolving ridges commencing at the shoulder angulation; shoulder of the whorls more or less smooth, with an obscure median revolving line, and a prominent subsutural one; aperture about the length of the spire, or slightly exceeding it, the canal gently curved, moderately contracted, and somewhat expanding at the extremity; outer lip thin, and showing internally the external ornamentation; base with numerous revolving lines, which alternate in coarseness.

"Length, 1¼ inches. Knight's branch, Clark Co., Alabama."

Our figure represents the typical Woods bluff form. Specimens from Bell's landing and occasionally at Woods bluff show a less marked carination and the space between the upper carinal line and the suture is traversed by two or more spiral lines, there are more spirals on the back of the anterior canal, the columella is also nearly rectilinear. This species doubtless merges into *F. mortoni* Lea.

Localities.—Alabama: Woods bluff, Gregg's landing, Bell's landing. Lower Peach Tree, Butler, Hatchetigbee bluff, Choctaw corner.—Aldrich. Knight's branch, Cave branch.—Heilprin.

Type.—Probably in Acad. Nat. Sci. Phila.

Specimen figured.—Woods bluff; Paleont. Museum, Cornell University.

Fusus ottonis, Pl. 5, fig. 5.

Syn. *Fusus meyeri* (See Bull. Am. Pal., vol. 1, p. 201, pl. 18, fig. 12, 1896).
Fusus ottonis Ald., Bull. Am. Pal., vol. 2, 1897.

The type specimen of this species is herewith refigured. As observed in vol. 1, p. 201, this is considerably different from the Midway form.

Lignitic localities.—Alabama: Woods bluff, and according to Aldrich, also at Lower Peach Tree.

Type.—Woods bluff, Aldrich collection.

In the Lea Memorial collection there is a *Fusus* with finer costation and less angulation at the middle of each whorl. It is probably a new species, though the striation suggests a relationship with this species. It is from Bell's.

Fusus rugatus, Pl. 5. fig. 6.

Syn. *F. rugatus*, Ald., Bull. 1, Geol. Surv. Ala., p. 22, pl. 5, fig. 9.
F. rugatus, Har., Proc. Acad. Nat. Sci. Phila., 1896, p. 478, pl. 22, fig. 8.

Aldrich's original description.—"Shell fusiform, spire high, suture linear; whorls carinated, concave and smooth above, rounded below, the periphery of each whorl with numerous tubercles, some of them reaching to a second revolving raised line below; the whorl next above the body whorl showing two tuberculated lines below the carina; body whorl showing four rows of spinous lines, contracted rather abruptly below them; canal covered with distant spiral rows of sharp spines; aperture small, angulated posteriorly, terminating in a long, narrow canal.

"*Locality.*—Gregg's landing, Alabama.

"The type specimen is broken, but other specimens likewise broken show a long, narrow canal, spirally striated to the end."

Type.—Aldrich's collection.

Specimen figured.—Gregg's landing; Lea Memorial collection.

Fusus (Buccinofusus) harrisi, Pl. 5, fig. 7.

Syn. *Fusus harrisi* Ald., Bull. Am. Pal., vol. 1, p. 64, pl. 5, figs. 2, 8.
Buccinofusus harrisi Cossm., Revue Bibliographique, 1895, p. 35. (From Journal de Conchyliologie, 1895.)

Aldrich's original description.—(*Op. cit.*)—In most specimens there is a broad, but well defined retral curve in the lines of growth as well as in the ribs on the humeral slope. In this respect the ribs remind one slightly of *Buccinum undulatum*, but in the latter the lines of growth do not follow the curvature of the ribs. Neither our nor Aldrich's figures show the feature clearly.

Localities.—Alabama: Gregg's landing; Yellow bluff.

Types.—Aldrich's collection.

Specimen figured.—Gregg's landing; Paleont. Museum, Cornell University.

Exilia pergracilis, Con.

See Bull. Am. Pal., vol. 1, p. 204.

Aldrich finds this species at Nanafalia, (see Bull. 1, Geol, Surv. Ala., p. 58), a Lignitic locality. This is one of the specimens obtained by Conrad through Dr. Showalter and labelled simply "Alabama," though the lot of fossils were said to have come from a comparatively northern locality; doubtless this came from Matthews' landing. Heilprin, strangely enough, had "Claiborne, Ala," put on the label.

De Gregorio and Cossmann suggest the marked similarity or even identity of this with Aldrich's *Fasciolaria pergracilis.* With good specimens of both before me I must confess I can see no similarity between these forms. *Exilia* has three embryonic smooth whorls followed by the spiral whorls which are ribbed longitudinally with a slight Pleurotomoid flexure not far below the suture. Over these ribs pass fine, incised, revolving lines. The ribs on the upper spirals of *F. pergracilis* are rectilinear and perpendicular. The lower whorls possess broad, incised spirals, across which vertical lines pass as in *Actæon.* It also has faint columellar plaits.

Clavilithes kennedyanus, P. 5, fig. 8.

Syn. *Clavilithes kennedyanus* Har., Proc. Acad. Nat. Sci. Phila., 1895, p. 73, pl. 7, fig. 8.

Harris' original description.—"General form as figured; whorls 10 or 12; 1 and 2 probably smooth; 3–10 with nodular ribs most prominent on the lower portions of the whorls, crossed by raised spiral lines and by even lines of growth ; body whorl in the type specimen very poorly preserved, but showing few signs of costæ ; columella ponderous.

"*Locality.*—Smithville, Bastrop county, Texas.

"*Geological horizon.*—Lower Claiborne Eocene.

"*Type*—Texas State Museum."

This species, unlike *C. humerosus*, runs up to a fairly sharp apex. Its penultimate and body whorls closely resemble *C. vicksburgensis.*

Lignitic localities.—Alabama : Woods bluff ; Nanafalia.

Specimens figured.—Paleontological Museum, Cornell University.

Latirus tortilis, var. **nanafalius,** nov. var., Pl. 5, fig. 9.

This differs from typical *tortilis* of the Midway, (see Bull. Am. Pal. vol. 1, p. 203), by having a shorter spire, more pointed spines and only one very faint raised line on the columella representing apparently the upper faint one in *tortilis.* The peculiar microscopic markings on the exterior, caused by the fine lines of growth becoming somewhat imbricate as they pass over spirals, is alike in both forms and leads one instinctively to group the two together, though they differ considerably in form.

Locality.—Alabama : Nanafalia.

Type of variety.—Paleontological Museum, Cornell Univ.

Siphonalia, sp., No. 1, Pl. 5, fig. 10.

Siphonalia, sp., No. 2, Pl. 6, fig. 1.

The fact that our *Claiborne* Eocene fossils were first to be described makes our stratigraphic treatment of the Eocene fauna, from Midway upwards, occasionally very difficult. Many short, semi-fusiform shells were described by Lea and Conrad from Claiborne whose synonymies have been and perhaps ever will be in doubt. Here are doubtless ancestral types of one or more of those forms ; but we must postpone giving final names to them until their Claiborne and Lower Claiborne allies have been most carefully studied.

No. 1 is from Yellow bluff, where it is quite common.

No. 2 is from Hatchetigbee bluff.

Both are in the Paleontological Museum of Cornell University.

Turbinella (Glyptostyla?) baculus, Pl. 6, fig. 2.

Syn. *Turbinella baculus* Ald., Bull. 1, Geol. Surv. Ala., 1886, p 27, pl. 6, figs. 2, a.

Aldrich's original description.—"Shell robust, broadly fusiform; whorls five,—two forming a nucleus, next two cancellated. Body whorl large and globose; revolving striæ alternately coarse and fine, well marked, while the longitudinal ones on it become faint.

"Aperture over half the length of the shell; outer lip smooth; columella with two nearly equal erect plaits; callus thin, spreading; canal short, open and recurved. No umbilicus.

"*Locality.*—Bell's landing, Alabama.

"A specimen in the State Collection is over twice as large as the type, but imperfect."

The general appearance of this shell with its twisted canal is precisely *Strepsidura*; it has no sharp basal fold like that genus but has, instead, higher up, two well formed transverse folds like *Glyptostyla* Dall.

Localities.—Alabama: Gregg's and Bell's landings.

Type.—Aldrich's collection.

Specimen figured.—From Gregg's; Paleont. Museum, Cornell University.

Pyropsis perula, Pl. 6, fig. 3, a.

Syn. *P. perula* Ald., Bull. 1, Geol. Surv. Ala., 1886, p. 25, pl. 3, fig, 4.
" " Har., Bull. Am. Pal., vol. 4, p. 204, pl. 19, fig. 2.
" " Har., Proc. Acad, Nat. Sci. Phila., 1896, pl. 21, fig. 1.

Though the large rough stems of this species are by no means rare, its occurrence in the form indicated by the figure is quite phenominal.

Lignitic localities.—Alabama : Woods bluff ; Aldrich records it also from Gregg's and Tuscahoma. Maryland : Casts from Ft. Washington and localities in Virginia indicate the probable presence of this species in the Lignitic of the Maryland-Virginia basin.

Specimen figured.—Woods bluff ; Lea Memorial Collection, Acad. Nat. Sci. Phila.

Chrysodomus engonata, Pl. 6, fig. 4.

Syn. *Fusus* (*Hemifusus ?*) *engonatus* Heilp., Proc. Ac. Nat. Sci, Phila., 1880, p. 372, pl. 20, fig. 8,
Fusus engonatus Ald., Geol. Surv. Ala., Bull. 1, p. 52, 1886.

Heilprin's original description.—"Shell turreted, of about ten volutions, the first three whorls smooth and convex, the remainder strongly carinated, and traversed by numerous fine revolving lines, which on the median portion of the body whorl alternate with intermediate finer striæ ; body whorl impressed immediately below the carination (shoulder angulation) ; lines of growth sinuous, and approximating the characteristic lines of the Pleurotomidæ ; aperture considerably exceeding the spire in length ; columella slightly arcuate, and presenting a rudimentary fold at about its central portion.

"Length, 1⅓ inches. Woods bluff, Clarke Co., Ala.

"This species resembles the *Fusus bifasciatus* of Deshayes, (Annimaux sans Vertèbres, Bassin de Paris, 11, pl. 84, figs. 15, 16,) from the Paris basin, but may be readily distinguished from that species by its more slender form."

This species is found in the lower Claiborne beds of Texas ; in the Lignitic of Alabama at Woods bluff, on the Tombigbee ; near Butler ; mouth of Bashi creek ; and Nanafalia.

Three of the embryonic whorls of this species are smooth and rotund and increase rapidly in size ; the fourth is rotund and non-carinate, but is marked by a net-work of lines, faint at first but stronger below ; the fifth whorl is also marked by longitudinal and spiral lines and is carinate centrally.

Type.—Presumably in the Philadelphia Academy, though not seen by the writer.

Specimen figured.—Paleontological Museum, Cornell University.

Sipho tuomeyi, Pl. 6, fig. 5.

Syn. *Bulbifusus tuomeyi* Ald., Bull. 1, Geol. Surv. Ala., 1886, p. 23, pl. 6, figs. 12a.

Aldrich's original description.—"Shell large, bulbiform ; whorls seven ; spire moderate ; body whorl very large and globose, flattened above and slightly concave, contracted below and finely striated ; aperture oblong-ovate ; outer lip smooth within ; columella strongly excavated, canal wide and curved.

"*Locality.*—Bell's landing, Alabama.

"This species may only be a strongly marked variety of *B. inauratus* Con., * * * but the younger specimen * * * from Gregg's landing differs from Conrad's species in having finely revolving lines over its whole surface, whorls convex, closely appressed at the suture, while the other has the whorls concave, the lines obsolete on the central part of the body whorl, is shouldered at the suture, which is in a groove, and generally has the first four whorls of the spire with a row of revolving nodes above the suture."

This is a very thin delicate form, found at Gregg's landing. Aldrich's type specimen bearing the original label with statement that it is the type and has been figured, says plainly "Gregg's landing."

This thin shell with very rounded or bulging spiral whorls may possibly be related to *Mazzalina* but it seems to us closer still to the living *Sipho ventricosus* off the coast of Newfoundland.

Specimen figured.—Paleontological Museum, Cornell University.

Chrysodomus striata, Pl. 6, fig. 6.

Syn. *Cominella striata* Ald., Bull. 1, Geol. Surv. Ala., 1886, p. 26, pl. 5, fig. 4.

Aldrich's original description.—"Shell ovate, fusiform ; whorls five to six, with fine transverse lines, shouldered. Suture in a depressed groove. Lines of growth sinuous, giving the shell rather a rough exterior. Body whorl contracted rapidly from the center toward the base. Striæ coarser on the basal portion; spire about one third the length of the shell: apex blunt; aperture oblong-ovate, smooth within. Columella broadly reflected; canal produced canaliculate at base.

"*Locality.*—Alabama: Hatchetigbee bluff.

"Differs from the previous species, [*C. hatchetigbeensis*,] by being striate, its more produced spire and fusiform shape.

"The outer tip [lip?] is broken away, but the lines of growth indicate a semicircular slit, as in the former species."

When viewed from the apex, this shell shows quite a prominent broad channel just below the suture. Below there are indications of short, slight ribs or faint spines. The lines of growth in passing from the latitude of faint spines bend to the left as they pass upwards and over the broad channel to the suture. This reminds one of *Levifusus* and we may well wonder if the canaliculate fulgurs may not have had a similar form for their prototype.

Type and specimen figured.—Aldrich's collection.

Siphonalia subscalarina, Pl. 6, fig. 7.

Syn. *Fusus* (*Strepsidura*) *subscalarinus* Heilp., Proc. Ac. Nat. Sci. Phila., 1880, p. 372, pl. 20, fig. 7.

Heilprin's original description.—"Shell somewhat bucciniform; whorls about eight, sub-angular, the first three or four smooth, the remainder ornamented with both longitudinal costæ and revolving striæ, the latter showing a tendency to alternate in size; the costæ are arcuate, not in a regular continuous series, those on the body whorl extending considerably below the middle of the whorl; aperture about the length of the spire, the canal somewhat reflected; columella covered with a callous deposit, considerably twisted; outer lip dentate within.

"Length, 1 inch. Knight's branch; Cave branch, Clarke Co., Alabama.

"This species greatly resembles the *Fusus scalarinus* of Deshayes (Coquilles Fossiles, II, p. 574, pl, LXXIII, figs. 27 and 28), but may be distinguished by the lesser prominence of its costæ, and by the presence of well defined striæ over the entire surface of the whorls. In this last respect, as well as in the subangulated form of the whorls, it also differs from the *Fusus scalariformis* Nyst (Coquilles et Polypiers Fossiles, p. 504, pl. XL, figs. 5a, 6), from Lethen, Belgium.

Localities.—Alabama : Woods bluff ; Gregg's landing ; Bell's ; Lower Peach Tree ; Cave branch : Knight's branch ; Choctaw corner ; Hatchetigbee.

Type.—Probably somewhere in the Acad. Nat. Sci., Philadelphia.

Levifusus trabeatus, Pl. 6, fig. 8.

Syn. See Bull. Am. Pal., vol. 1, p. 209.
Also Proc. Acad. Nat. Sci., Phila., 1896, p. 479, pl. 22, fig. 11.

Conrad's original description.—See vol. 1, p. 209.

As remarked in Proc. Acad. &c., this figure represents one of the largest and most compact varieties of the species. "The labral liræ are unusually well marked ; the carinal nodules are very large but imperfectly defined." The specimen belongs to the Lea Memorial Collection and was obtained by C. W. Johnson, at Bell's landing.

Lignitic localities.—Alabama : Hatchetigbee ; Woods bluff ; Yellow bluff ; Choctaw ; Bell's ; Tuscahoma ; Nanafalia. Butler.—Aldrich. Texas : Sabinetown.

Type.—Acad. Nat. Sci. Phila.

Levifusus supraplanus, nov. sp., Pl. 6, fig. 9.

In a former report, (Bull. Am. Pal., vol 1, p. 207), I considered this form as a variety of *L. suteri.* Specimens in my own collection, in the University's, and in that of the Lea Memorial at the Academy of Natural Sciences fail to show such similarities with *suteri* as to warrant their specific identity with that species.

Specific characterization.—Size and general form as figured ; spiral whorls about eight ; surface smooth and almost shining, with lines of growth somewhat sinuous and irregular ; median carination sharply defined, bearing about ten flattened spines, over whose summits passes a heavy, raised spiral line; body whorl rendered slightly bicarinate by a strong, raised spiral, proceeding forward from the upper limit of the aperture; below this spiral are others diminishing in strength to the end of the canal.

Differs from *suteri* by lack of a bisected carina, lack of spiral lines on the spire, and the presence of a long, straight, Fusoid canal.

Localities.—Alabama: Gregg's and Bell's landings; Yellow bluff.

Type and specimen figured.—Paleontological Museum, Cornell University.

Levifusus pagoda, Pl. 6, fig. 10.

Syn. *Pleurotoma pagoda* Heilprin, Proc. U. S. Nat. Museum, vol. 3, p. 149, pl. fig. 1.
Fusus pagodiformis Heilp., Proc. Ac. Nat. Sci. Phila., 1880, p. 375.
" " Ald., Geol. Surv. Ala., Bull. 1, p. 55, 1886.
" " Heilp., Proc. Acad. Nat. Sci., 1890, p. 395.
Levifusus pagoda var. Har. Bull. Am. Pal., vol. 1, p. 207, pl. 19, fig. 8.
Levifusus pagoda Ald., Bull. Am. Pal., vol. 2, p. 170, pl. 4, fig. 3.

For Heilprin's original description, see Bull. Am. Pal. vol. 1, p. 207.

Plate 6, fig. 10, shows a very stout specimen of this species, with carinal spines unusually close to the suture. The great mass of Woods bluff specimens are more fusiform with carinal spines raised some little distance above the suture. Their largest or body whorl is apt to have few and weak spines. At Gregg's landing the specimens are more in harmony with the figure, though the spines on the larger whorls of specimens from that landing are rather more numerous. At Yellow bluff the specimens are still stouter and spines still more numerous. From Oakhill, (See Bull. 1, p. 207), a Midway locality, the species again goes back to its normal size, but is more strongly marked by spiral heavy lines on the body whorl and a tendency to split the carinal spines by an incised spiral line, such as is well developed in *L. suteri*.

Lignitic localities.—Alabama: Woods bluff; Choctaw corner; Bell's landing; Gregg's landing; Tuscahoma.

Type.—U. S. National Museum.

Cyllene bellana, Pl. 6, fig. 11.

Syn. *C. bellana* Har., Proc. Acad. Nat. Sci. Phila., 1896, p. 479, pl. 23, fig. 4.

Harris' original description.—Size and general form as indicated by the figure; whorls about 8; embryonic 3 small, smooth, others finely costate and with fine revolving lines; costæ strongest on the central portion of the whorls (*i. e.* on the shoulder) vanishing above, reaching the suture below; columella twisted, *Strepsidura*-like below; labrum lirate within; exterior of body whorl with extremely fine revolving lines on its central portion, and with coarser lines above the carina and near the base.

"*Locality.*—Bell's landing, Alabama." Also at Gregg's.

Type.—Returned with others to Wagner Institute, but reported by Johnson as missed, when box was unpacked.

Levibuccinum lineatum, Pl. 6, fig. 12.

Syn. See Bull. Am. Pal. vol. 1, p. 211.

This species attains its best development in the Lignitic, and our figure shows a perfect specimen.

Lignitic locality.—Alabama: Woods bluff.

Type.—In the Philadelphia Academy of Natural Sciences, if not lost.

Levifusus indentus, nov. sp., Pl. 7, fig. 1.

Specific characterization.—Size and general form as indicated by the figure; spire consisting of about seven whorls, apex generally destroyed; submedial carina ornamented with about nine rather narrow, well marked though obtusely pointed spines; showing to the suture below but influencing the supra-humeral region but little; spines on larger whorls more or less flattened or pinched longitudinally; spiral lines numerous and fine; longitudinal lines with a slightly *Surcula*-like retral sinus on the humeral region ; body whorl often showing before each narrow, blunt-pointed, vertically flattened spine an indentation, or a slightly depressed channel, most evident at the upper left hand base of each spine and continuing with more or less distinctness to the upper right hand portion of the next spine to the left ; spiral striation coarser below the carina, the lines often making an upward flexure while passing the longitude of each spine.

After reading Dall's account of the many varieties of *Fulgur spiniger* (vol. III, p. 107, Trans. Wag. &c.), that are found in the Oligocene, and noting too that Aldrich cites "*Fusus*" *spiniger* from Tuscahoma, I cannot help wondering whether the form under discussion might not be specifically identical with *spiniger*. But, so far, none of the varieties of the latter species seem to have the comparatively Fusoid spire of *indentus*, nor are the spines imbricate as described by Dall *op. cit.* p. 110. We are inclined to think *spiniger* a true *Fulgur*, while this species has the Pleurotomoid features of *Levifusus*. That *Fulgur* is derived from *Levifusus* there can be little or no doubt. *L. pagoda* when well developed in the lower Lignitic approaches this form.

Fragments of a large Fulguroid species in the Lea Memorial collection from Yellow Bluff and Bell's landing may belong to a variety of this species. The whorls are more squarely shouldered and the spines less flattened vertically.

Localities.—Alabama : Nanafalia. Georgia : Bluff at Ft. Gaines.

Type.—Paleontological Museum, Cornell University.

Triumphis hatchetigbeensis, Pl. 7, fig. 3.

Syn. *Cominella hatchetigbeensis* Ald., Bull. 1, Geol. Surv. Ala., 1886, p. 26, pl. 3, figs. 6, a, b.
Eburna hatchetigbeensis de Greg., Mon. Faun. Eoc. Ala., p. 108, 1890.

Aldrich's original description.—"Shell bucciniform, oblong-ovate ; whorls shouldered, with a depressed groove at the suture. Spire short, smooth ; apex obtuse. Body whorl strongly shouldered, contracted below, with numerous revolving lines on the basal portion, which are obsolete on the middle part ; the centre is flattened, sometimes concave. Aperture oblong-ovate; outer lip sinuous, with a distinct, rounded semicircular slit on the upper third below the shoulder, smooth internally; inner lip smooth, reflected, thickened above and below.

"*Locality*.—Hatchetigbee bluff. In two different horizons there.

"This peculiar form has such a distinct slit in the outer lip * * *, that it may deserve a sub-generic place, though it resembles the living *Cominella maculata* Martyn, from New Zealand. In one specimen the shoulder of the body whorl rises so as to almost hide the succeeding whorl, giving the shell a triangular form.

The generic affinities of this species are not well known. It seems to us that it should be the type of a new subgenus if not of a genus placed near *Triumphis*. *T. distorta* Linné, has very much the general appearance of this species but lacks all traces of the Pleurotomoid labral sinus as well as the broad tooth-like projection near the base of the labrum.

Type.—Aldrich's collection.

Tritonidea johnsoni, Pl. 7, fig. 4.

Syn. *Pisania* (*Tritonidea*) *johnsoni* Ald., Bull. Am. Pal., vol. 1, p. 65, pl. 5, fig. 9.

For Aldrich's original description, *loc. cit.*

The tpye, in Aldrich's collection, from Bell's landing is herewith redrawn. We have found no additional specimens of this species.

Mazzalina var. **plenus,** Pl. 7, fig. 5.

Syn. *Bulbifusus plenus* Ald., Bull. 1, Geol. Surv. Ala., 1886, p. 23, pl. 6, fig. 7.

For *M. inaurata* see our following bulletins on the Eocene of Alabama.

Aldrich's original description.—"Shell broadly fusiform; whorls probably six, surface on upper whorls with a few distinct revolving lines, which on the upper part of the body become faint; body whorl swollen above, rapidly narrowing below, where it is spirally striated with alternate raised lines; whorls thickened and constricted at suture and suddenly rounded; suture hidden in the groove thus formed; surface finely marked with lines of growth; aperture oblong-ovate, terminating in a rather broad canal, which turned to the left; outer lip slightly crenate within; columella smooth, no perceptible callus on posterior part.

"*Locality.*—Bell's landing, Alabama.

"Resembles somewhat the Jacksonian species of *Clavella*, but its whorls are few, spire low and canal recurved. The apex is worn but appears to be blunt."

When we consider the enormous amount of variation shown by this shell in the Lower Claiborne, Claiborne, and especially in the Jackson beds of Arkansas, we are obliged to regard this as but a mild divergence from typical *inaurata*.

The type of this variety, herewith figured, is from Aldrich's collection.

Euthria dubia, Pl. 7, fig. 6.

Syn. *Pisania? dubia* Ald., Bull. 1, Geol. Surv. Ala., 1886, p. 25, pl. 3, fig. 13.
Pisania dubia Coss., Ann. Geol. et Pal., 12e liv., 1893, p. 34.

Aldrich's original description.—"Shell fusiform; whorls rounded, about eight in number; spire acute; surface covered with equidistant revolving lines, which are broadly rounded, the spaces between smooth.

"Lines of growth obsolete; the embryonic whorls are smooth. Aperture oblong-ovate; canal moderate; outer lip thickened and striate within; inner lip smooth, slightly excavated, thickened and angular at junction with canal.

Locality.—Lower bed, Wood's bluff.

"The absence of a callosity at the posterior end of the aperture makes the generic place doubtful."

This species resembles several of the modern *Euthria*. There seems to be no trace of a posterior tooth on the columella, hence it is not a *Pisania*. Its slightly irregular mode of growth recalls some species of *Neptunea*.

Locality.—Woods bluff.

Specimen figured.—Paleont. Museum, Cornell Univ.

Metula sylværupis, n. sp., Pl. 7, fig. 7.

Specific characterization.—Size and general form as shown by the figure ; embryonic three whorls smooth ; the fourth cancellated, the fifth, sixth and seventh cancellated, slightly shouldered, with one or two comparatively large spiral lines on the humeral slope ; growth irregular, interrupted by one or two low varices on each whorl ; body whorl with markings similar to those on the whorls just above, though with finer lines near the base ; labrum sharp-edged, but thickening rapidly behind, varix-like, with close-set, short striations (or elongate crenulations interiorly), noticeably thickened exteriorly ; labial callosity thickened above.

Locality.—Alabama : Woods bluff ; Hatchetigbee.

Type and specimen figured.—Woods bluff ; Paleontological Museum, Cornell University.

Macron philadelphicus, n. sp., Pl. 7, fig, 8.

Specific characterization.—Form and size as figured ; whorls probably about eight, though only five showing in the only specimen known ; spiral whorls with about seven broad low undulations or ribs extending from the suture below, three-fourths the way to the suture above where a subsutural contraction cuts them off ; body whorl smooth except at base where alternating spirals occur ; shoulder sharp, channeled with a flange appressed to the whorl above ; labium callous ; umbilicus incipient.

Locality.—Alabama : Yellow Bluff.

Type.—Lea Memorial Collection, Academy of Natural Sciences, Philadelphia.

Nassa cancellata, Lea.

Aldrich cites this species from Hatchetigbee, Woods bluff, Butler, Bell's and Gregg's landings, Alabama. Our collections afford no representations from Lignitic localities. See *N. exilis.*

Nassa (——) exilis, Pl. 7, fig. 9,

Syn. *Simpulum* (*Epidromus*) *exilis* Con., Jour. Acad. Nat. Sci. Phila., vol. 4, p. 293, pl. 47, fig. 31, 1860.

Triton exilis Ald., Geol. Surv. Ala., Bull. 1, p. 56, 1886. ("*Nassa cancellata*" ?).

Triton exilis de Greg., Mon. Faun. Eoc. Ala., p. 98, pl. 7, fig. 44, 1890.

Cominella ? interanda Cossm., Ann. Geol. and Pal., 1893, p. 34.

Conrad's original description.—"Elongated; whorls seven, rounded; ribs longitudinal, numerous; revolving lines fine and raised, eleven or twelve on the penultimate whorl: body whorl striated to the base; spire much longer than aperture; columella plain and obtusely carinated at base; labrum striated within; peristome sinuous. Length ½ inch."

Some forms of this species, especially when the lower end of the columella has been broken off or eroded—which frequently happens—resemble closely *N. cancellata* Lea. Yet when examined under a hand glass these accidental features are readily detected; and I yet have to find any specimens of *cancellata* in Lignitic beds. De Gregorio correctly remarks: "la figure de Conrad laisse à désirer." Cossmann was perplexed at a specimen of this species sent him from Gregg's by Meyer under the name of *Buccinum sagenum*, and referred it to one of De Gregorio's many species, *i. e.* to *interanda*. He was again perplexed as to its generic position, referring it to *Cominella* with a query.

That this is not far from *Nassa cancellata* is evident from Hatchetigbee specimens which are shorter, coarser ribbed, and with columnar features not so sharply defined as in typical *exilis*.

Localities.—Alabama: Gregg's landing; four miles above Hamilton bluff on Alabama river; Hatchetigbee bluff.

Type.—Doubtless in Acad. Nat. Sci. Phila., though I fail to find reference to it in my notes.

Specimen figured.—From Gregg's landing; now in the Paleontological Museum, Cornell University.

Bulliopsis choctavensis, Pl. 7, fig. 10.

Syn. *Melanopsis choctavensis*, Ald., Geol. Surv. Ala., Bull. 1, p. 35, pl. 3, fig. 8, 1886.
Nassa calli Ald., Geol. Surv. Ala., Bull. 1, p. 27, pl. 5, fig. 5.
Pasithea de Greg., Faun. Eoc. Ala., p. 164, pl. 16, fig. 36, 1890.
Nasseburna calli de Greg., Faun, Eoc. Ala., p. 108, pl. 7, fig. 62, a, b, 1890.

Aldrich's original description.—"Shell oblong-ovate ; whorls six, shouldered ; spire obtuse, the upper part generally plicate ; suture impressed distinct. Body whorl constricted below the shoulder, smooth on the main part ; fine revolving lines below and often a few on the shoulder, sometimes continuing to the apex just below the suture. Aperture oblong-ovate, canaliculate at base ; outer lip smooth, slightly thickened within ; columella with a thickened and reflected callus."

I fail to see wherein *choctavensis* and *calli* differ much except in size.

I do not believe this belongs to the fresh water Melanian genus *Melanopsis* of the Old World. Nor do I believe Fischer is right, (see Manual Conch. p. 703), in referring Conrad's *Bulliopsis* to *Melanopsis*. This species has some resemblance to *Bulliopsis quadrata* Con. of the Miocene as Aldrich has stated ; and I am not sure but *Bulliopsis* should be put under *Buccinanops*, *i. e. Bullia*.

Localities.—Alabama : Hatchetigbee ; Woods bluff ; and according to Aldrich also at Butler, Choctaw corner. "*Calli*" is from Lisbon.

Type.—Aldrich's collection.

Specimen figured.—Hatchetigbee bluff ; Paleontological Museum, Cornell University.

Astyris subfraxa ,n. sp., Pl. 7, fig. 11.

Specific characterization.—General form and size as indicated by the figure ; embryonic whorls smooth at first, increasing rapidly in size, four or five in number, then two vertically ribbed, embryonic whorls ; below, three smooth spirals : body whorl strongly striated below, usually irregularly fractured ;

columella with traces of two plaits or rather mere pustules; labrum smooth within.

Differs from *bastropensis* Har. by having two instead of one costate embryonic whorl, is smaller and more robust.

Locality.—Alabama: Woods bluff.

Type.—Paleontological Museum, Cornell University.

Æsopus erectus, Pl. 7, fig. 12.

Syn. *Sipho erecta* Ald., Bull. Am. Pal., vol. 1, p. 65, pl. 5, fig. 7.
Probably not *S. ? erecta* Har., Proc. Ac. Nat. Sci., Phila., 1896, p. 476, pl. 21, fig. 3.

For Aldrich's original description see vol. 1, p. 65.

We have recently added a large number of this species to the University collection from Woods bluff and it proves to be quite different from what we had supposed from an examination of the figure. Its relationship to the Columbellidæ is certain, but to which genus it will finally be referred is now uncertain. The exterior markings recall many species of *Turricula* and *Mitra*, but its aperture is decidedly of the *Astyris* type. There are however no labral crenulations. On the columella of the type specimen there are traces of two faint oblique folds. The present figure represents an adult shell from Woods bluff, and now in the University collection.

This species recalls *Æsopus filosus* of Australian waters.

Terebrifusus amœnus, Pl. 7, fig. 13.

Syn. *Buccinum amœnum*, Con., Foss. Sh. Tert. Form., p. 45, Nov., 1833.
Terebra gracilis Lea., Cont. to Geol., p. 166, pl. 5, fig. 171, Dec., 1833.
Terebra multiplicata H. C. Lea, Am. Jour. Sci., vol. 40, p. 101, pl. 1, fig. 19, 1840.
Terebrifusus amœnus Con., Am. Jr. Conch., vol. 1, p. 28, 1865.
Terebrifusus amœnus Coss., Ann. Geol. et Pal., 1893, p. 37, pl. 2, fig. 14.
Terebrifusus amœmus Ald., Bull. Am. Pal., vol. 1, p. 62, pl. 2, fig. 15, 1895.

Conrad's original description.—"Subulate, with about six slightly convex volutions; with distant obtuse longitudinal ribs, and acute prominent equidistant spiral striæ; aperture contracted, less than half the length of the shell; base very slightly reflected." From Claiborne.

Lignitic locality.—Alabama; Woods bluff.

Type.—Academy of Natural Sciences, Philadelphia.

Specimen figured.—Paleontological Museum, Cornell University.

Mitrella mississippiensis. Pl. 7, fig. 14.

Syn. *Columbella mississippiensis*, Ald. and M'r. Jr., Cinn. Soc. Nat. Hist., vol. 9, pt. 2, p. 43, pl. 2, fig. 17, 1886.
C. mississippiensis, Ald., Bull. Am. Pal., vol. 1, p. 65, pl. 2, figs. 19, 19 a.

Aldrich and Meyer's original description—"Spire elevated. Whorls nine, slightly convex; the last four with an impressed line along the suture. Base of body whorl spirally striated. Columella excavated, anteriorly with three tubercles. Outer lip thickened, crenulated within by about seven striæ, of which one in the middle is the largest. Newton."

Aldrich remarks (*loc. cit. p. 65*) that the Woods bluff form "differs from the typical only by the plaits on the columella being nearly obsolete."

Type.—Aldrich's collection.

Specimen figured.—Aldrich's collection; from Woods bluff.

Mitrella alabamensis. Pl. 7, fig. 15

Syn. *Latirus alabamensis* Ald., Bull. Am. Pal. vol. 1, p. 63, pl. 21, fig. 17

For Aldrich's original description.—(*Loc. cit.*)

I am inclined to think this and the following are both members of the *Columbellidæ*. Though they do not conform in general outline to typical *Mitrella*, they are perhaps as near that as any other established genus.

Locality.—Ala.: Hatchetigbee.

Type and specimen figured.—Aldrich's collection.

Trophon sublevis, sn.p., Pl. 8, fig's. 1 and 19?

Specific characterization.—Size and general form as indicated by the figure; whorls seven, embryonic three smooth, spire and body whorl smooth, polished, but with nine sharp-edged costae on each whorl, becoming somewhat pointed on the shoulder; faint undulations indicating indistinct, distant spirals between the ribs; outer lip thickened, with five crenulations within, the upper the stronger; no umbilicus.

Pl. 8, fig. 19 is a specimen belonging perhaps to a varietal form of this species. The substance of the shell is white, while that of *sublevis* is horn-color; the humeral points are more distant from the suture above; the shell is comparatively longer; the lip and hence every rib, while seeming to join onto the rib in the whorl above, turns abruptly to the left and joins really onto the next rib in advance. This specimen is from the Lea memorial collection, from Gregg's landing.

Locality.—Ala.: Gregg's landing.

Type and specimen figured.—Paleontological Museum, Cornell University.

Trophon caudatoides. Pl. 8, fig. 2.

Syn. *T. caudatoides*, Ald., Bull. 1, Ala. Geol. Sur. p., 19, pl. 6, fig. 4, 1886.

Aldrich's original description.—"Shell with numerous varices; whorls seven, uppermost two smooth, the others angulated by the variceal nodes and crossed by a few revolving lines, which are rather coarse and somewhat alternate; one to four thickened lamelliform varices on different specimens at irregular distances apart. Aperture ovate; outer lip expanded and crenate within; columella smooth, twisted below; canal rather abruptly turned to the left.

"*Locality.*—Hatchetigbee bluff, Ala."

One specimen from the same locality has a much more complete spire, but less complete outer lip.

Type and specimen figured.—Aldrich's collection.

Trophon elegantissimus. Pl. 8, figs. 3 and 6.

Syn. *Murex elegantissimus* Ald., Bull. Am. Pal., vol. 1, p. 65, pl. 5, fig. 3, 1895.

Aldrich's original description.—(*Op. cit.*)

It was most probably a form of this species that Aldrich characterized as "*Murex engonatus?* Con." in Bull. No. 1, Geol. Surv. Ala., p. 56, 1886, from Gregg's landing. I have little doubt that the larger specimen herewith figured is an adult form of this species. The tpye is herewith figured. See fig. 3.

Locality.—Ala.: Gregg's landing.

Type.—Aldrich's collection.

Trophon gracilis. Pl. 8, fig. 4.

Syn. *Trophongracilis* Ald., Bull. 1, Geol. Surv. Ala., p. 19, pl. 5, fig. 6, 1886.
Fusus bellus (*partim*) de Greg. Eoc. Faun. Ala., p. 91, 1890.
Suessionia gracilis Cossm. Ann. Geol. and Pal. 1893, p. 35.

Aldrich's original description.—"Shell acuminate, whorls ten, rounded; spire high, with three embryonic whorls, the first two smooth, the next showing longitudinal varices, the balance with numerous (in the type nine) strong varices, which are, when perfect, thin, fringing and sigmoid; six or more revolving lines cut the edge of the varices into an equal number of crenulations, these revolving lines being strongest at their intersecting points; aperture ovate, terminating in a narrow canal which turns strongly to the left and slightly upward; outer lip sharp, thickened and crenulated within; three slight protuberances on the anterior part of the columella near the canal.

"*Locality.*—Lower bed, Woods bluff, Ala.

"Only two specimens found. This species is more acuminate and has a shorter canal than is usual in living forms."

Muricidea imbricatula. Pl. 8, fig. 5.

Syn. *Latirus imbricatulus* Har., Proc. Ac. Nat. Sci. Phila., 1891, p. 476, pl. 21, fig. 2.

"*Specific characterization.*—General form and size as indicated by the figure: whorls 10; 1–4 embryonic, smooth; the remaining spiral whorls with about 7 costæ crossed by about 6 very strong revolving striæ between which there are an equal number of fine spirals. Labrum lirate within; columella very much twisted and showing signs of plications, especially at the basal angle. Umbilicus not large, but well defined. The most peculiar feature of this species is the imbricate appearance of the incremental lines. This strongly reminds one of some of the Muricidæ. The general form of the species is much like *Latirus rugatus* Dall from the Ballast Point Silex beds.

"*Locality.*—Woods bluff."

We are led to believe by new material that the striations on the columella referred to above are due to the revolving striæ showing through the thin columella collosity, and hence do not partake of the nature of those of *Latirus.* This is not far from *Trophon elegantissimus*, but differs in having much finer and more regular imbrications; with ribs, revolving lines, imbrications and all extending from suture to suture. The humeral region of *elegantissimus* is nearly plain.

Type.—Lea Memorial Collection, Acad. Nat. Sci., Phila.

Phyllonotus morulus, Pl. 8, fig. 7.

Syn. See Bull. Am. Pal., vol. 1, p. 214, pl. 20, fig. 1, 1895.
Murex morulus Har., Proc. Ac. Nat. Sci. Phila., 1896, p. 476, pl. 20, fig. 12.

Conrad's original description.—See this work, vol. 1, p. 214.

Conrad's original specimen, the type, was doubtless obtained from Matthew's landing along with *Volutilithes limopsis*, *V. rugatus*, *and Exilia pergracilis*, though he did not state, nor did he doubtless know its exact provenance. It is, however, finely developed at Woods bluff, as shown by the accompanying figure.

Cornulina armigera, Pl. 8, figs. 8-11.

Syn. *Melongina? armigera* Con., Foss. Sh. Tert. Form., No. 3, p. 30, Sept. 1833.
Fusus taitii Lea, Cont. to Geol., p. 152, pl. 5, fig. 159, Dec. 1833.
Monoceros armigerus Con., Foss. Sh. etc., 2d ed. p. 37, pl. 15, fig.

1, 1835.
Cornulina armigera Con., Proc. Ac., etc., 1853, p. 321.
Cornulina armigera Con., Amer. Jr. Conch., vol. 1, p. 21, 1865.
Cornulina armigera Ald., Geol. Surv. Ala., Bull. 1, pl. 50, 53, 1886.
Cornulina armigera Dall, Trans. Wag., etc., vol. 3, p. 118.

Conrad's original description.—"Shell subglobose, ponderous; body whorl with a double row of short, thick spines, one on the shoulder, the other near the middle: three or four strongly impressed lines towards the base: columella and lip callous; basal emargination profound, spire subconical, convex, constituting nearly half of the shell, the humeral spires revolving upon it. Length 2½ inches; breadth 2 inches.

"*Locality.*—Claiborne, Ala.

"Cab. Acad. N. S."

This species shows a considerable variation as to ornamentation. The Gregg's landing specimen herewith figured shows but one row of spines; that at Nanafalia shows a rudimentary series below; while the Hatchetigbee specimen has three rows.

Lignitic localities.—Ala.: Yellow bluff; Nanafalia; mouth of Bashi creek; Gregg's; Nanafalia; Woods bluff; Hatchetigbee.

Texas: Sabinetown.

Triton tuomeyi. Pl. 8, fig. 12.

Syn. *Ranella* (*Argobuccinum*) *tuomeyi* Ald., Bull. 1. Geol. Surv. Ala., p. 20, pl. 3, fig. 3, 1886.

Aldrich's original description.—"Shell oblong-ovate, canal strongly recurved, bent upwards; whorls seven; spire elevated, pointed, the first two whorls smooth, the others cancellated, the longitudinal lines forming tubercles at intersections; tubercles sharp, transverse, strongly developed on the periphery of the body whorl and next one above, generally three large ones on the body whorl between the varices; transverse striæ numerous, composed of coarse lines, having three finer ones between, and others between these; line of growth fine; varices strong, pitted on the back side; suture impressed, slightly shouldered; aperture ovate; outer lip with a strong varix, nine tubercles within, canal nearly as long as the aperture.

"*Locality.*—Lower bed, Woods bluff, Ala.

"Young shells show more tubercles between the varices than the type. Named in honor of the late Prof. Michael Toumey."

So far we have observed this species only at Woods bluff, though it doubtless will be found elsewhere at a similar horizon. In the type specimen the varices happen to be continuous, one above the other, but that is not true of the specimen herewith figured. In this, the varices of each succeeding whorl surpass those of the whorl before by one rib-space. It seems that Fischer is right in referring "*Ranella*" *gigantea* of the Mediterranean to the genus *Triton*, on account of its lack of a posterior canal. The species *tuomeyi* certainly falls in the same group with *gigantea*.

This differs from *showalteri* by its different location of the varix before the aperture and the less pronounced angulation of the whorls.

Type.—Aldrich's collection.

Specimen figured.—Paleontological Museum, Cornell University.

Triton (Ranularia) eocensis, Pl. 8, fig. 13.

Syn. *Fulgur eocense* Ald., Bull. Am. Pal., vol. 1, p. 62, pl. 4, fig. 7, 7a.
T. (Ran.) eocensis Har., *idem.* p. 215, pl. 20, fig. 3.
T. (Ran.) eocensis Har., Proc. Ac. Nat. Sci. Phila. 1896, p. 479, pl. 23, fig. 1.

For Aldrich's original description.— (*Loc. cit.*)

As observed in my article published in the Proceedings of the Academy of Natural Sciences of Philadelphia, "this is the most perfect specimen of this species yet found." Its apex is somewhat eroded and might be represented a little more acute. Strangely enough, it does not show varices on the whorls, as is usual in specimens of this species.

Lignitic locality.—Ala.: Gregg's landing.

Type.—Aldrich's collection.

Triton (Epidromus) otopsis, Pl. 8, fig. 14.

Simpulum otopsis Con., Museum, Acad. Nat. Sci. Phila. (Conrad's original label).

Syn. *Simpulum autopsis* Con., Jr. Acad. Nat. Sci. Phila., vol. 4, p. 293, pl. 47, fig. 25, 1860.
S. (*Epidromus*) *otopsis* Con., Am. Jr. Conch., vol. 1, p. 20, 1865.

Conrad's original description.—"Subfusiform; whorls rounded, seven in number, cancellated; revolving lines most conspicuous, alternated in size, the largest beaded finely, and about fourteen in number on the body whorl, exclusive of beak; aperture with beak about half the length of the shell; apex obtuse, three first whorls smooth and the second and third turned. Length 1⅛ inch."

This is put by Conrad along with his specimens from "a locality farther north in Alabama than any Mr. Tuomey had explored." So far I have collected no specimens of this species and the specimens sent me under this name by Aldrich are *Cancellariæ*. If Eocene at all it will doubtless be discovered at Bell's, Gregg's, or Matthew's landing.

Type and specimen figured.—Acad. Nat. Sci. Phila.

Very kindly loaned me for examination and figuring by the officers of that institution.

Fusoficula juvenis, Pl. 8, figs. 15 and 16.

Syn. See Bull. Am. Pal., vol. 1, p. 216.

Two extreme varieties have been chosen for figuring. Any shade of intermediate mutations can be obtained from any good locality like Woods bluff. The apex of this species is formed by (1) a very small smooth whorl nearly enclosed by (2) a much larger smooth whorl followed by (3) about one-third of a volution characterized by spiral striations and afterward by vertical heavy lines, then (4) a slight non-conformability with a slight varix, then the remainder of the whorls ornamented as shown by the figures. The above-mentioned embryonic whorls are set at a slightly different angle from the axis of the remaining spirals. In old specimens the labrum is thickened within.

Lignitic localities.—Ala.: Gregg's landing; Lower Peach Tree; Woods bluff; Hatchetigbee; 3 mi. s. w. of Thomasville. Aldrich reports it also from Bell's; Tuscahoma; Nanafalia; Butler.

Texas: Sabinetown.

Specimen figured.—Perfect form from Gregg's; fragment from Woods bluff.

Now in Paleont. Mus., Cornell Univ.

Fulguroficus triserialis, Pl. 8, fig. 17.

Syn. *Fulgur triserialis* Whitf., Amer. Jr. Conch., vol. 1, p. 260, 1865.
Pyrula smithii (Sow.) Ald., Jr. Cin. Soc. Nat. Hist., July, 1885.
Fulgur triserialis Ald., Bull. 1, Geol. Surv. Ala. 1886, p. 24, pl. 1, fig. 23b.
Fulguroficus argutus Clark, U. S. G. S., Bull. 141, p. 68, pl. 12, fig. 1, 1896.

Whitfield's original description.—"Shell thin, clavate or pyriform; spire short, consisting of four (or more) volution, flattened above, and produced below into a long, slender canal; marked on the periphery or largest part of the volution by three rows of lanceolate nodes or subspines, the upper one being the most prominent; aperture large elongate elliptical; canal straight; columella slender and smooth; entire surface marked by sharp revolving lines.

"*Locality.*—Nine miles below Prairie Bluff, Ala."

The ornamentation on Gregg's and Bell's landing specimens is quite variable and the *argutus* type is represented.

Not uncommon at Gregg's landing, where doubtless Whitfield's specimens were obtained. Also found at Bell's.

Type.—Hall's collection.

Specimen figured.—Paleont. Mus., Cornell Univ.

Cassidaria brevidentata, var. Pl. 8, fig. 18,

Syn. *C. brevidentata* Ald., Jr. Cinn. Soc. Nat. Hist., 1885, p. 152, pl. 3. fig. 20.
C. crevidentata Ald., Geol. Surv. Ala., Bull. 1, pl. 1, fig's. 19, 20.
C. brevidentata Har., Proc. Ac. Nat. Sci. Phila., 1896, p. 479, pl. 22, fig. 10.

Aldrich's original description.—"Shell oblong-oval, whorls seven; suture channeled; surface covered with fine revolving striæ; coarser, distant lines upon the body whorl, giving the shell the carinated aspect of the genus; lines of growth fine, a few coarser ones showing on the line of the tubercles; apex smooth; whorls of the spire carinate and slightly tubercled; a row of upright longitudinal nodes on the shoulder of the body whorl, none below; a single, strong varix on the body whorl; aperture ovate; inner lip spread over the whorl, with three plications on the upper part, smooth in the central part and plicate below; outer lip reflected, plicate on the inner edge above and below, smooth in the center; canal narrow, strongly twisted. Length 1.4; breadth .9.

"*Locality.*—Red bluff, Miss.

"This species differs from *C. carinata* Lam. in having a single, strong varix. It is lighter in substance. I describe it with reluctance, basing its specific difference principally upon the presence of the strong varix."

As stated in the Proc. Acad. Nat. Sci. Phila., p. 479, "This specimen shows an unusually large number of nodules on the humeral carina. In front, the two lower carinæ are without nodules, while on the back all three carinæ are strongly nodular.

"*Locality.*—Bell's landing, Ala."

We have found no additional specimens.

Cassidaria dubia Ald.

Syn. *C. dubia* Ald., Jr. Cinn. Soc. Nat. Hist., 1885, p. 153, pl. 3, fig. 21.
C. dubia Ald., Geol. Surv. Ala., Bull. 1, p. 33, pl. 1, fig. 21, 1886.

Aldrich's original description.—"Shell ovate; whorls, six to seven; sculptured the same as *C. carinata* Lam; nodes sharp, longitudinal, situated on the shoulder of the body whorl; suture channeled; whorls of the spire with a circle of nodes, sub-central; outer lip toothed above and plicate on the whole of the inner edge; inner lip strongly plicate-costate its entire length; toothed above. Length about one inch; breadth .7.

"*Locality.*—Headwaters of Bashia creek, Clark county, Ala., near Woods bluff.

"Differs from all other species mentioned in the plications of the aperture. Prof. A. Heilprin (Proc. Acad. Nat. Sci., 1880, p. 365), in his list of fossils from Cave Branch, mentions a 'Cassidaria (fragment) closely allied to *C. carinata* Lam,' which is no doubt the species above described."

We have found nothing but fragments of this species in the Lignitic, and the type figured by Aldrich is quite imperfect. When better material is obtained it can be figured to advantage.

Cypræa smithii, Pl. 8, fig. 20.

Syn. *C. smithii* Ald., Geol. Surv. Ala., Bull. 1, 1886, p. 33, pl. 5, fig. 3.
C. smithi Har., Proc. Acad. Nat. Sci. Phila., 1896, p. 477, pl. 21, fig. 4.

Aldrich's original description.—"Shell oblong-ovote, rather flat, surface smooth; labrum crenulate within, smooth on the base and flattened, reflected somewhat and raised above base of shell; aperture slightly crenulate within, expanded below.

"*Locality.*—Gregg's landing, Ala."

Also found at Woods bluff, where it "is broader posteriorly than typical *smithi*, and has a less conspicuous posterior termination of the labium, yet it is most likely of the same species. It seems to be the forerunner of *C. dalli* Ald."—Har.

Type.—Aldrich's collection.

Aporrhais gracilis, Pl. 9, fig. 1.

Syn. *A. gracilis* Ald., Geol. Surv. Ala., Bull. 1, 1886, p. 32, pl. 5, fig. 14.

Aldrich's original description.—"Shell fusiform, whorls eight, spire high; embryonic whorls smooth, the others to the body whorl with longitudinal ribs which curve to the left into the suture and are crossed by fine revolving lines; body whorl expanded into a broad outer lip, furnished with two digitations, the posterior one the largest, rising in some specimens into a long, sharp point, strongly grooved to the apex. The outer lip extends up the spire to the top of the body whorl only; the groove in the anterior digitation rather faint; surface of body whorl with two revolving carinæ marking these grooves and covered with faint revolving lines; aperture small, inner lip with a spreading callus; canal moderate, terminating in a sharp point slightly recurved.

"*Locality.*—Gregg's landing, Ala.

"Quite common; the digitations are subject to considerable variation, the younger forms have only the posterior one.

"The embryonic apex is missing in every specimen. One example has made a double outer lip; the posterior digitation lying over each other and distinct; the anterior ones coalescent."

Calyptraphorus trinodiferus Pl. 9, fig. 2, a.

Syn. *C. trinodiferus* Con., Proc. Ac. Nat. Sci. Phila., 1857, p. 166.
Colyptraphorus Gabb., A. J. Conch. vol. 4, 1868, p. 142, pl. 13, fig. 10.
C. trinodiferus Con., J. Ac. Nat. Sci. Phila., vol. 4, pl. 47, fig. 29.

Conrad's original description.—"Subfusiform, with three distant nodes on the upper part of the body volution; spire subtriangular, having curved longitudinal ribs visible beneath the tunic; rostrum of the spire elongated and curved; labrum with a prominent angle above.

"From the Eocene of Alabama, Mr. Showalter."

Heilprin has improperly put "Claiborne, Ala." on Conrad's label.

Localities.—Ala.: Bell's and Gregg's landings; 4 mi. above Hamilton bluff, Ala. river; Hatchetigbee; Woods bluff; Tuscahoma.

Tex.: Sabinetown.

Type.—Phila. Academy.

Specimen figured.—From Gregg's; Paleont. Mus. Cornell Univ.

Melania sylværupis, n. sp. Pl. 9, fig. 10.

Specific characterization.—Size and form as indicated by the figure; spiral whorls but slightly inflated above, but becoming more carinated below; body whorl very angular or carinate with nine short oblique costæ, marked below by a few rather faint revolving lines. The only specimen known is somewhat incomplete, but it shows very distinctly a new form of a brackish or fresh water type in this generally marine fauna.

Locality.—Ala.: Woods bluff.

Type.—Lea Memorial collection, Paleont. Mus., Cornell Univ.

It is quite probable that land shells also may be found at Woods bluff, since silicious pebbles fully ½ inch in diameter are not uncommon, showing that land and inflowing streams were not far away when these beds were being laid down.

Melania trigemmata, Pl. 9, fig. 3, a, b.

Syn. *Turbonilla* (*Chemnitzia*) *trigemmata* Con., Jour. Acad. Nat. Sci. Phila., vol. 4, p. 288, pl. 47, fig. 33.
T. (*C.*) *trigemmata* Ald., Geol. Surv. Ala., Bull. 1, p. 52, 1886.
Scalaria? trigemmata de Greg., Mon. Faun. Eoc., etc., p. 131, 1890.
Rissoia? trigemmata Con., Annal. Geol. et Pal., 1893, p. 27.

Conrad's original description.—"Turrited; whorls seven convex; ribs distant, with three subequal tubercles; the ribs become obsolete towards the suture, where there are two revolving lines, minutely beaded in a line with the ribs; suture profound, an impressed line revolving immediately above; base with six revolving carinated lines. Length 1¼ inches.

"Accompanying the above are specimens of univalves embracing the following Eocene species: *Mitra pactlis* C., *Cancellaria gemmata* C., *C. alvaata* C., *Calyptraphorus trinodiferus* C. All except the last are Claiborne species."

Probably related to "*Terebra*" *plicifera* Heilp. Some specimens have a close resemblance to *Melania præcessa* Desh.

Locality.—Ala.: Woods bluff.

Specimen figured.—Paleontological Museum, Cornell University.

Potamides fulvarupis, n. sp. Pl. 9, fig. 4.

Specific characterization.—Form and size as indicated by the figure; whorls increasing rapidly in size and giving the shell a ventricose appearance; upper whorls with traces of costations from suture to suture, but only evident near the upper part of the whorl, where there is a broad, low or vertically compressed nodule on what would be the upper portion of each rib. Just above and below this row of nodules there is a well marked depression or depressed broad line. Traces of two low, broad spirals are on the whorls below the crenules; on the body whorl there are also four strong basal spirals. Lines of growth are not evident, but there was probably a considerable backward swing to them in the middle of each whorl.

Closely resembles specimens in the Lower Eocene of the Paris basin.

Localities.—Ala.: Yellow bluff; Bell's landing.

Type and specimen figured.—Yellow bluff; Lea Memorial collection, Acad. Nat. Sci. Phila.

Cerithium delicatulum, Pl. 9, fig. 5.

Syn. *Cerithium delicatulum* Ald., Bull. Am. Pal., vol. 2, p. 179, pl. 2, fig. 9.

For Aldrich's original description, see above reference.

Locality.—Ala.: Hatchetigbee bluff.

Cerithium tombigbeense, Pl. 9, fig. 6.

Syn. *C. tombigbeense* Ald., Bull. 1. Geol. Surv. Ala., 1886, p. 34, pl. 3, fig. 7.
P. (*Cerithium*) *tombigbeensis* Dall., Tr. Wag., etc., vol. 3, p. 287.

Aldrich's original description.—"Shell elongated, whorls probably twelve; suture distinct, situated in a depressed space; surface of the uppermost whorls smooth, those following transversely striated, the lower ones with numerous oblique longitudinal ribs, rising into tubercles on the center of the body whorl and the two next above; a wavy line just below the suture, making a slight shoulder to the whorls. Lines of growth sigmoid, fine and numerous upon the body whorl, obsolete above. Aperture ovate, outer lip reflected below, making a short, open canal.

"*Locality.*—Woods bluff, Ala.

"Only one specimen found; the mouth is broken away, rendering it impossible to determine its generic position absolutely. The apex is also missing, but is probably sharp. Suggests the genus *Melania.*"

Cerithiopsis fluviatilis, Pl. 9, fig. 7.

Syn. *C. fluviatilis* Ald., Bull. Am. Pal., vol. 2, p. 178, pl. 2, fig. 3.

For Aldrich's description, see the above reference.

Localities.—Ala.: Woods bluff; Choctaw corner.

Specimen figured.—Aldrich's specimen from Choctaw corner.

Cerithiopsis conica, Pl. 9, fig. 8.

Syn. *C. conica* Ald., Bull. Am. Pal., vol. 2, p. 178, pl. 2, fig. 4, 1897.

For Aldrich's description, see above reference.

The specimens in hand, from Woods bluff, agree very well with Aldrich's description and figure, except his specimen was much smaller than this, and no mention is made of the raised lines or plaits on the columella. The largest whorl of our specimen has a somewhat finer costation than the upper whorls have; the costæ are more arcuate and thread-like.

Lignitic locality.—Ala.: Woods bluff.

Specimen figured.—Paleontological Museum, Cornell University.

Cerithiopsis terebropsis, Pl. 9, fig. 9.

Specific characterization.—Size and form as shown by the figure; whorls with four distinct, raised lines or bands, crossed by a large number of nearly vertical ribs, nodular at intersections of spirals; base marked by about six strong spirals, diminishing in strength anteriorly; columella biplicate within, but this feature does not show from the outside in perfect specimens; plications extend to apex, as proven by broken specimens; columella somewhat callous at aperture; columella perforate, when viewed from below.

Locality.—Ala.: Woods bluff.

Type.—Paleontological Museum, Cornell University.

Serpulorbis sylværupis, n. sp. Pl. 10, fig. 1.

Specific characterization.—Size and general appearance as figured; exterior marked by about twenty primary and an equal number of secondary longitudinal, raised lines, the former granular or nodose; smaller end of the shell nearly or quite smooth.

Locality.—Ala.: Woods bluff.

Type.—Paleontological Museum, Cornell University.

Turritella clevelandia, var. Pl. 10, fig. 2.

Syn. *T.? carinata* Ald., Geol. Surv. Ala., Bull. 1, p. 52, 1886.
T. clevelandia Har., Geol. Surv. Ark., Rept. for 1892, vol. 2, p. 176, pl. 6, fig. 9, 1894.

This Lignitic form corresponds more nearly to *clevelandia* than any other described species; though it is with some hesitation that I place this under that name. The sutures are more deeply impressed in *clevelandia* and the spiral marking more pronounced, as will appear from the original description of that species:

Harris' original description.—"Size and general form as indicated by the figure; whorls 13 or 14; generally ornamented by about three prominent revolving lines and a few subordinate ones; from the uppermost and lowermost of the revolving lines the whorls slope abruptly to the suture, while between these lines the sides of the whorls are straight."

The type of *clevelandia* is from the Jackson beds of Arkansas and is deposited in the collection of the U. S. Nat. Mus.

Lignitic localities.—Ala.: Woods bluff; Ozark; 4 mi. above Hamilton bluff; Hatchetigbee?; 3 mi. s. w. of Thomasville.

Specimen figured.—Woods bluff; Paleontological Museum, Cornell University.

Turritella mortoni. Pl. 10, fig's. 3, 4.

Syn. *T. mortoni* Con., Jour. Acad. Nat. Sci. Phila., vol. 6, p. 221, pl. 10, fig. 2, 1830.
T. carinata de Greg. (*ex. parte*) Mon. Faun. Ala., 1890, p. 122, pl. 11, fig's. 3, 4, 5.
T. mortoni Har., Bull. Am. Pal., vol. 1, p. 224, 1896.

Conrad's original description.—"Shell turreted, conical, thick, with revolving distant, and finer intervening, striæ; whorls with an elevated acute carina near the base of each; volutions about eleven, and the striæ are the largest on the elevations of the whorls, which are slightly concave above and abruptly terminate at the sutures; the lines of growth on the last whorl are strong and much undulated.

"I dedicate this species to my friend Dr. S. G. Morton, who has so ably illustrated the geology of this country connected with its organic remains.

"Cabinet of the Academy."

This is one of the most abundant and characteristic species of our lower Eocene deposits both in the Gulf and Chesapeake embankments. It presents a great many varietal forms in the Lignitic and finally merges into *T. carinata* of the Claiborne Eocene. We have noted in the American Journal of Science, vol. 47, p. 302-303, fig's. 1, 2, 1894, the form or variety styled *post-mortoni* from the Lignitic of Alabama (called *carinata* by de Greg.) characterized by comparatively faint spiral striation and by a sharp, strong carina not so basally located as in the typical form. This variety leads up to the form found in the Lower Claiborne beds at Lisbon and elsewhere, and this in turn to the typical T. *carinata* Lea.

Lignitic localities.—Ala.: Tuscahoma; Nanafalia; Yellow bluff; Bell's landing; Gregg's landing.

Ga.: Ft. Gaines.
Va.: Ratcliff wharf, Rapp. R.; Evergreen; Aquia creek; Potomac creek.
Md.: Ft. Washington.

Specimens figured.—Fig. 3, Nanafalia; fig. 4, Bell's; Paleontological Museum Cornell University.

Turritella humerosa, Pl. 10, fig's. 5, 6, 7.

Syn. *T. humerosa* Con., (See Bull. Am. Pal., vol. 1, p. 224).

The more typical form is represented by fig. 5. Fig. 6 is Whitfield's *multilira* and fig. 7 is Whitfield's *eurynome* and also practically Aldrich's *bellifera* (Jr. Cinn. Soc. Nat. Hist., July 1885, p. 150, pl. 3, fig. 13. See also Jr. Cinn. Soc. Nat. Hist., July 1887, p. 81). The species is extremely variable in surface marking, but there is no chance for drawing lines of specific demarcation within its bounds. All shades of variation occur in one and the same bed. It ranks secondary to *mortoni* as a typical lower Eocene species.

Lignitic localities.—Ala.: Nanafalia; Tuscahoma; Yellow bluff; Bell's and Gregg's landings.

Va.: Evergreen; Aquia creek; Potomac creek; Ratcliff wharf.
Md.: Ft. Washington.

Specimens figured.—Fig. 5, Nanafalia; fig. 6, Gregg's landing; fig. 7, Bell's landing; Paleontological Museum Cornell University.

Turritella præcincta, Pl. 10, fig. 8.

Syn. *Turritella præcincta* Con., Proc. Ac. Nat. Sci. Phila., 1864, p. 211.

Conrad's original description.—"Turrited, broad at base; sides straight; a profoundly elevated, thick, angular carina revolves at the summit of each volution, gradually disappearing at the fourth whorl; carina slightly channeled above and having a single revolving line beneath its juncture with the whorls, which have each three revolving lines, the inferior one most prominent. Length 3⅝ inches; width of body whorl, independant of carina, ¾ inch.

"*Locality.*—Dallas Co.? Alabama Eocene.

"This large species differs from *T. mortoni* in having a larger and more amply elevated carina, larger and fewer revolving striæ, etc. It is allied to *T. rotifera* Lam. The specimen described was loaned for the purpose by Mr. R. P. Whitfield. Other specimens are in Barnum's Museum, N. Y."

As a rule there is no need of confounding this with any other *Turritella*, but some of the large Yellow bluff specimens are intermediate between this and *humerosa*.

Localities.—Ala.: Gregg's landing; Bell's landing; Yellow bluff; Tuscahoma.
Va.: Aquia creek.

Type?

Specimen figured.—Gregg's landing; Paleont. Mus., Cornell University.

Mesalia pumila, var. **alabamiensis,** Pl. 10, fig. 9.

Syn. See Bull. Am. Pal., vol. 1, p. 226 and 227, pl. 22, fig. 1, 1896.

This is an extremely variable form, as noted on the pages of Bull. Am. Pal., vol. 1, just referred to. The figure herewith given shows a typical form of the variety *alabamiensis*. Others at Nanafalia show ornamentation like that of typical *pumila*, though perhaps the revolving lines are a little more sharply carinate. In the same bed are typical *alabamiensis*. Gregorio has suggested the reference of *alabamiensis* to *vittata* Lam. The resemblance is occasionally striking.

Lignitic localities.—Ala.: Gregg's and Bell's landings; Yellow bluff; Pine Hill; Nanafalia.

Melanopsis planoidea, Pl. 10, fig. 10.

Syn. *M. planoidea* Ald., Bull. Am. Pal., vol. 1, p. 67, pl. 3, fig. 7, 1895.

Aldrich's original description.—(*Loc. cit.*)

As remarked below, this is doubtless the normal form, while *anita* is an old incrassated form of the same species.

Locality.—Ala.: Gregg's landing.

Type and specimen figured.—Aldrich's collection.

Melanopsis anita, Pl. 10, fig. 11.

Syn. *Melanopsis anita* Ald., Geol. Surv. Ala., Bull. 1, 1886, p. 35, pl. 5, fig. 12.
Pasithea anita de Greg., Faun. Eoc. Ala., 1890, p. 164.
? *Melanopsis planoidea* Ald., Bull. Am. Pal., vol. 1, p. 67, pl. 3, fig. 7, 1895.

Aldrich's original description.—"Shell ovate, spire short, surface smooth, body whorl large; aperture large, angular posteriorily, caused by a thick deposit of callus; outer lip sharp, thin; callus reflected below, terminating in a small excision.

"*Locality.*—Ala.: Gregg's landing."

This seems to be a true *Melanopsis*, though it may be an offshoot of *Bullia* or *Pasithea*. I am inclined to think this is but an old incrassated form of *M. planoidea*.

Locality.—Ala.: Gregg's landing.

Type and specimen figured.—Aldrich's collection.

Tuba antiquata, Pl. 10, fig. 12.

Syn. *Littorina antiquata* Con., Foss. Sh., etc., Sept. 1883, p. 35.
Tuba alternata Lea, Cont. to Geol., Dec. 1833, p. 128, pl. 4, fig. 118.
Tuba striata Lea, *idem*, p. 128, pl. 4, fig. 117.
? *Tuba sulcata* Lea, *idem*, p. 129, pl. 4, fig. 119.
Tuba antiquata Ald., Geol. Surv. Ala., Bull. 1, 1886, p. 53.
Tuba striata Dall, Trans. Wag., etc., vol. 3, p. 320, 1893.
Tuba antiquata Ald., Bull. Am. Pal., vol. 2, p. 173, pl. 5, fig. 7.

Conrad's original description.—"Shell conic-acute, somewhat ventricose, with numerous revolving, very elevated lines, alternating with smaller ones, and longitudinal approximate, regular striæ; sutures deeply impressed; whorls convex; umbilicus distinct, rounded; mouth orbicular; slightly contracted by the rotundity of the penultimate whorl. Length ½ an inch.

"*Locality.*—Claiborne, Ala. Cab. Acad. N. S."

Lignitic localities.—Ala.: Woods bluff; Choctaw corner.

Type.—Academy of Natural Sciences, Philadelphia.

Specimen figured.—Aldrich's specimen and figure, (young).

Solarium sylværupis, Pl. 11, fig. 1.

Syn. *S. texanum* Dall, (*non* Gabb), Trans. Wag., etc., vol. 3, p. 326.
S. sylværupis Har., Proc. Ac. Nat. Sci. Phila., 1896, p. 477.

The only description this form has had is by Dall. He says: "The upper surface without spiral striation, the middle of the whorl impressed, the suture simple-edged except in the very young, the periphery wider and less decumbent; the umbilicus smaller with the carina very finely transversely wrinkled, the base smooth or with a few obsolete spiral lines." It is here compared to *S. scrobiculatum.*

Having examined the type of *S. texanum* in the Academy's collection, it appears that *S. texanum* is synonymous with *scrobiculatum*, hence the necessity of the new name proposed in the Academy's Proceedings.

Localities.—Ala.: Woods bluff; near Choctaw corner.

The type of this new species may be considered to be the specimen herewith figured, from Woods bluff, in the Paleontological Museum of Cornell University.

Solarium cupola, Pl. 11, fig. 2.

Syn. *S. cupola* Heilp., Proc. Ac. Nat. Sci. Phila., 1880, p. 375, pl. 20, fig. 14.
S. cupola Ald., Bull. 1, Geol. Surv. Ala., 1886, p. 51.
S. cupola Dall, Tr. Wag., etc., vol. 3, p. 326, 1893.

Heilprin's original description. — "Shell convexly conical, mound-like, of about five volutions; whorls ornamented with alternating coarse and very fine concentric lines, and appearing double from a medial impression (the shell apparently of twice the number of volutions that it actually possesses); base similarly ornamented as the upper surface, convex, and strongly margined by the prolongation inferiorly of the outer wall; umbilical margin finely crenulated, the umbilicus broadly open, and exhibiting the concentrically striated internal volutions of the apex; aperture rhomboidal.

"Length, ⅔ inch; diameter, 1¼ inch. Cave branch; Knight's branch; Woods bluff, Clarke Co., Ala."

Localities.—Ala.: Woods bluff; near Choctaw corner.

Aldrich gives also: Bethel; Butler; 4 mi. s. Mt. Sterling.

Specimen figured.—Woods bluff; Paleontological Museum, Cornell University.

Solarium huppertzi var. Pl. 11, fig. 3.

Syn. *S. huppertzi* var. Har., Proc. Ac. Nat. Sci. Phila., 1896, p. 477, pl. 21, fig. 5.

S. huppertzi was described from Smithville, Bastrop Co., Tex., in the Proc. Ac. Nat. Sci. Phila., 1895, p. 83, pl. 9, fig's. 10, 10 a. We postpone a full discussion of this species till our next bulletin, for doubtless more light will be had on the subject from collections of Lower Claiborne horizon from Louisiana. Suffice it to say here, as we did in the Academy's Proceedings for 1896, that this form or variety has much finer markings and granulations than typical *huppertzi* has.

Locality.—Ala.: Woods bluff; now in both Cornell Univ. Mus. and that of the Acad. Nat. Sci. Phila.

Specimen figured.—Lea Memorial Collection, Acad. Nat. Sci., Phila.

Solarium greggi, Pl. 11, fig's. 4, a.

Syn. *S. greggi* Har., Proc. Ac. Nat. Sci. Phila., 1896, p. 480, pl. 23, fig's. 5, 5a.

Harris' original description.—"Whorls about five. Nuclear whorls rounded, smooth; remaining whorls with three crenulate spiral lines and one smooth, strong spiral line just above the suture. Periphery about the body whorl with one deeply incised spiral line, thus rendering it obtuse. Umbilicus small, with radii from its periphery about one-third way across the body whorl, and having a raised spiral coarsely crenulate carina medially located."

Locality.—Ala.: Gregg's landing.

Type and specimen figured.—Lea Memorial Collection, Acad. Nat. Sci. Phila.

Solarium elaboratum,

Conrad's original description.—(A. J. S., vol. 23, p. 344, 1833) "Shell discoid, with numerous revolving crenulated striæ of different sizes; beneath slightly channeled on the sub-margin, with a few strong grooves; margin of the umbilicus profusely crenulated; the crenulations extending to the apex; aperture nearly circular. Length, one-third of an inch.

"*Locality.*—Claiborne, Ala."

Variety **delphinuloides** Heilprin, Pl. 11, fig. 5,

Syn. *S. delphinuloides* Heilp., Proc. Ac. Nat. Sci. Phila., 1880, p. 375, pl. 20, fig. 13.
S. delphinuloides Ald., Geol. Surv. Ala., Bull. 1, p. 51.
S. delphinuloides Dall, Trans. Wag., etc., vol. 3, p. 324.

Heilprin's original description.—"Shell convexly conical, of about seven volutions; the whorls ornamented with several beaded revolving lines, two or more of which near the upper margin, and one near the basal margin being the most prominently defined; base convex sub-marginally channeled, and ornamented with numerous finely beaded revolving lines, which become more prominent in the umbilical region; umbilical volutions distinct to the apex, transversely striated, supermedially carinated; umbilical margin crenulated; aperture subcircular.

"Length, ½ inch; diameter, ¾ inch; Woods bluff, Clarke Co., Ala."

This differs from *elaboratum* principally by its generally lower form, more finely yet more prominently beaded lines, with an unusually strong spiral some little distance above the periphery and suture.

Specimen figured.—Woods bluff; Paleontological Museum, Cornell University.

Variety **intusum** var. nov. Pl. 11, fig. 8.

Syn. *S. delphinuloides* Ald., Geol. Surv. Ala., 1886, Bull. 1, p. 57.
S. elaboratum Dall, Trans. Wag., etc., vol. 3, p. 324, 1893.

Differs from *elaboratum* by having two sub-equal umbilical ribs, by having its periphery well rounded or obtuse, by its more depressed form. The diagonally elongated crenulations on the striæ resemble closely those on *elaboratum*, though there is more similarity in the strength of the lines and markings above than there is in typical *elaboratum*.

Localities.—Ala.: Gregg's landing and Yellow bluff.

Type of variety.—Paleont. Mus., Cornell Univ.; from Gregg's.

Solarium leanum, Pl. 11, fig. 6.

Syn. *S. leanum* Dall, Trans. Wag., etc., vol. 3, p. 325, pl. 22, fig. 12.

Dall's description is as follows: "The umbilical carina is annulate with nineteen strong, transversely-ruled tubercles, separated from the strong similar umbilical rib by an excavated sulcus; the rib is prominent, and looks, to a casual inspection, as if it were the top of the umbilical wall of the whorl, which is not the case; the shell is depressed, with a wide, thin carina, blunt and slightly undulate on the edge; both the under and upper surfaces of the whorls are concave; the keel overhangs the suture in front; the base outside of the umbilical carina is smooth, with a single fine thread in the bottom of the excavation; on the summit, above the keel, are four fine beaded or undulated spirals, separated by much wider interspaces, those next the suture stronger than the other two. Alt. 5.5; diam. 11.0 mm.; the apical whorls are estimated for, being defective in the type." Wautubbee, Miss.

The markings on the specimen herewith figured are a little more pronounced than Dall's description would indicate. Below towards the exterior there are several fine spiral lines.

Locality of specimen figured.—Ala.: Hatchetigbee.

Type.—National Museum, Washington, D. C.

Specimen figured.—Lea Mem. Coll., Phila. Acad.

Solarium bellense n. sp., Pl. 11. fig. 7.

? *S. scrobiculatum* Ald., Geol. Surv. Ala., 1886, Bull. 1, p. 57.

Specific characterization.—Size and general form as indicated by the figure; whorls about six; surface above covered with a great number of very fine revolving lines, with a trace of a large revolving line just above the suture; below with somewhat coarser alternating spirals and near the periphery showing one strong raised line; umbilical carina without traces of dentition; lines of growth on umbilical wall nearly vertical near the umbilical carina but, just before reaching the whorl above, swinging forward and truncated by a well-defined spiral sulcus.

Locality.—Ala.: Bell's landing.

Type and specimen figured.—Lea Mem. Coll., Phila. Acad.

Solarium sp.

Dall mentions *S. scrobiculatum* Con. and *S. cossmanni* Dall from Gregg's landing. We have as yet not found them in our Lignitic collections.

Discohelix verrili, nov. sp., (by Aldrich), Pl. 11, fig's 9, a.

Syn. *Orbis rotella* Ald., *non* Lea, Geol. Surv. Ala., 1886, Bull. 1, p. 53.

Aldrich has sent the following description of this new species, not in our collections:

"Shell of medium thickness, flattened above, with straight side meeting the upper surface at quite an angle; base extremely excavated, showing all the whorls which are six in number. Surface of the whorls nearly smooth, showing some very fine radial lines of growth, the outer edge of each whorl bordered by a raised and beaded rib, this line showing both above and beneath. The flattened outer edge of the body whorl bears a second beaded line above and two raised ones below near base with two or three very faint lines between. The apex is depressed below the plane of the top and the nucleus is smooth and inverted. Aperture semi-quadrate, wider at the outside, the whole aperture standing at an angle to the body of the shell; interior is thickened somewhat at the intersection of the angles.

"This shell is extremely rare. I found one specimen in 1885 and listed it in Bull. No. 1, Ala. Geol. Surv., 1886, p. 53, as *Orbis rotella* Lea. I have lately found two more specimens.

"The largest example is 15 mm. in width and 4 mm. high.

"This species differs from *Orbis rotella* Lea in size, in its aperture being more quadrate, whorls greater in number, and also in the extremely excavated base.

"*Locality.*—Choctaw Corner; Woods Bluff horizon."

Aldrich sent us a pencil drawing by Dr. Otto Meyer of the original discovery, and from this we have made our figures.

Hipponyx sylværupis n. sp. Pl. 11, fig. 10, a.

Specific characterization.—Size and form as indicated by the figure; beak eroded but showing little tendency to overhang; radii large, irregular, interrupted by deeply-incised lines, rendering them difficult to follow; each costal segment as it appears between two lines of growth is usually a little longer than it is wide, and is separated from the next costal segments on either side by spaces equal in width to the width of the costa or rib.

Probably the same species referred to by Aldrich on p. 53, Geol. Surv. Ala., Bull. No. 1, 1886.

Differs from *H. pygmæa* by size, less overhang of beak, coarser, more interrupted radii, and character of radii in general. It has not the large, coarse, continuous plications of *H. ingrediens* de Greg.

Localities.—Ala.: Woods bluff; Choctaw corner.

Type.—Paleontological Museum, Cornell University.

Capulus expansus, Pl. 11, fig's. 11, 12.

Syn. *Velutina* (*Otina*) *expansa* Whitf., Am. Jr. Conch., vol. 1, p. 265, pl. 27, fig's. 14, 15, 1865.
Leptonotis expansa Con., Am. Jr. Conch., vol. 2, p. 76, 1866.
L. expansa Tryon, Str. and Syst. Conch., vol. 2, p. 208, pl. 64, fig's. 68, 69, 1883.
Capulus complectus Ald., Geol. Surv. Ala., Bull. 1, 1886, p. 34, pl. 6, fig's. 1, 1 a.
Velutina expansa Ald., Jr. Cinn. Soc. Nat. Hist., July 1887, p. 81.
Capulus complectus de Greg., Mon. Faun. Eoc. Ala., 1890, p. 145.
Velutina (*Leptonotis*) *expansa* de Greg., *idem*, p. 156.
Colyptræa trochiformis (in part) Dall, Tr. Wag., etc., vol. 3, p. 352, 1893.

Whitfield's original description.—"'Shell minute, broadly expanded; spire very low; volutions from two to three, the outer one forming the greater part of the shell; peristome continuing around the body of the volution to near the base of the columella; margin of the aperture flattened or slightly reflected; inner surface of the shell highly polished; exterior marked by irregular lines of growth. The different individuals differ somewhat in degree of expansion of the outer volution.

"*Dimensions.*— The largest individual seen measures .05 inch across the aperture.

"*Locality.*—Six miles below Prairie Bluff, Ala., in sand, filling the cavities of other shells."

Regarding this species "*Velutina expansa*" Aldrich says, *loc. cit.:* "Prof. Whitfield informs me this species was obtained from the dirt out of a large *Voluta newcombiana* Whitf. As the only locality of this species is at Bell's landing, the habitat of this form is fixed. The species has a very suspicious resemblance to a very young or embryonic *Infundibulum trochiforme* Lam."

The largest embryonic whorl is spirally lirate, and the smallest whorls are sunken or hidden by the largest, features not at all in harmony with Whitfield's "*V. expansa*," whereas the young of *C. complectus* Ald. are exactly *V. expansa* Whitfield. We have it in all stages of growth. The smallest whorls of the embryo are not sunken as in *Calyptræa trochiformis*, but appear like the smaller spirals of a very small *Natica*.

Localities.—Ala.: Woods bluff; Gregg's landing; Bell's landing; Nanafalia; 3 mi. s. w. of Thomasville. Hatchetigbee and Libson.—Aldrich.

Type.—Hall's collection.

Specimen figured.—From Woods bluff; Paleont. Mus., Cornell Univ.

Calyptræa aperta, Pl. 11, fig's. 13-16.

Syn. *Trochus apertus* Sol., Foss. Hant., 1766, p. 9, fig's. 1, 2.
T. opercularis Sol., *idem*, fig. 3.
Calyptræa trochiformis Lam., Ann. du Mus., vol. 1, p. 385, 1802; vol. 7, pl. 15, fig's. 3 a, b, c, d, 1806.
Trochus calyptræformis Lam., An. sans. Vert., vol. 7, p. 558, 1822.

Calyptræa truchiformis Desh., Coq. Foss. Env. Par., vol. 2, p. 30, pl. 4, fig's. 1, 2, 3, 1824.
Infundibulum trochiformis Lea, Cont. to Geol., 1833, p. 96, pl. 3, fig. 76.
I. urticosum Con., Foss. Sh., etc., 1833, p. 32.
I. trochiformis Con., Foss. Sh., etc., 1835, p. 46, pl. 16, fig. 18.
Trochita trochiformis Con., Am. Jr. Conch., vol. 1, p. 33, 1865.
T. trochiformis Ald., Geol. Surv. Ala., Bull. 1, 1886, pp. 52, 56.
Calyptræa trochiformis de Greg., Faun. Eoc. Ala., p. 145, pl. 13, 40-47.
C. trochiformis Dall (*partim*), Tr. Wag., etc., vol. 3, p. 352, 1893.
C. aperta Cossm., Ann. Geol. et Pal., 1893, p. 26.

Solander's original description.—"Trochus (*apertus*) testa gibboso-conica exasperata obliquata subtus concava, apertura angustata.

"Primo intuitu *Patellis* assimilatur illisque quæ *Labio interno* instructae sunt, *cfr. Linn. Syst. nat.* n. 654-658. Specimina autem perfecta *spiram* ostendunt completam, *anfractus* licet pauciores quam in congeneribus; *Apertura* etjam magis contracta est.

"Testa magnitudine Juglandis sed depressior, sæpeque minor; tabulæ imposita conum formans gibbosiusculum, quo etjam a congeneribus differt; externe scabra, subtus lævis, concava.

"Apertura angustata, lateribus magis roduntatis quam in reliquis hujus generis." From the Barton beds of Southern England.

American Lignitic localities.—Ala.: Woods bluff; Yellow bluff; Gregg's landing; Bell's landing; Ozark; 3 mi. s. w. of Thomasville.

Type.—British Museum.

Specimens figured.—Larger specimen from Gregg's; smaller from Woods bluff; Paleontological Museum, Cornell University.

Xenophora conchyliophora, Pl. 11, fig. 17.

Syn. *Trochus conchyliophorus* Born, Mus. Cæs. Ind., 1778, p. 333.
Phorus reclusus? Ald., Geol. Surv. Ala., 1886, Bull. 1, p. 52.
X. conchyliophora Dall, Trans. Wag., etc., vol. 3, p. 360, 1893.

I have little doubt but what Dall is right in referring the specimens from Woods bluff to this living species. Whether or not the Cretaceous specimens from Prairie bluff should be referred to the same depends on the verdict of paleontologists after better material than I have yet seen from that locality is obtained. Dall says:

"Since this group remounts in the geological scale to the Devonian, it is not so extraordinary that one of the species should persist from the uppermost Cretaceous to the present day. No differential characters have ever been recorded which would separate Morton's shell from the Eocene form which follows it, and I can assert with confidence that the latter cannot be discriminated from the Miocene and recent forms by any constant characters. If this succession be admitted, it is a strong testimony to the protective value of the device by which the members of this family defend themselves."

Lignitic locality.—Ala.: Woods bluff.

Specimen figured.—Paleontological Museum, Cornell University.

Natica semilunata, Pl. 11, fig's. 18-20.

Syn. *N. semilunata* Lea, Cont. to Geol., 1833, p. 108, pl. 4, fig. 93.
? N. perspecta Ald., Geol. Geol. Surv. Ala., Bull. 1, p. 56.
N. epiglottina, *et al.* of de Greg., Mon. Faun. Eoc. Ala.,p. 148, etc.
N. minor Coss., Ann. de Geol. et de Pal., 1893, p. 25.
N. semilunata Coss., Ann. de Geol. et de Pal., 1893, p. 25.
N. semilunata Dall, Trans. Wag., etc., vol. 3, p. 364.

Lea's original description.—"Shell subglobose, smooth; substance of the shell rather thin; spire slightly elevated; suture rather impressed; columella but slightly thickened, the callus being reflected at the middle of the umbilicus; umbilicus large and grooved; whorls five, inflated, slightly flattened below the suture; mouth semi-lunate, about two-thirds the length of the shell. Length .4, breadth 7-20 of an inch." From Claiborne, Ala.

The Lignitic beds offer greater varieties of this species than the Claiborne sand does. Dall is doubtless right when he says: "In this species the young has the umbilical rib very distinct, but in completely adult specimens the rib has frequently become so obsolete as to have practically vanished." A large and probably more or less diseased form is shown by fig. 19, which still retains a very sharply defined and large umbilical rib. This, however, is a rare exception.

Typical small specimens occur at Hatchetigbee, with strong umbilical ribs, much stronger than that represented by fig. 18, from Woods bluff. Larger specimens with not the slightest trace of this rib are common in the Lignitic. One is represented by fig. 20.

Sometimes the ribless, more elevated, smaller specimens have something of the appearance of broad varieties of *N. eminula*, but a glance at the suture will distinguish the two: *semilunata* is slightly flattened or shouldered just below the suture, while in *eminula* there is no trace of such a character and the lower whorls are tightly appressed at a small angle against the whorls above. There is even a slight indentation sometimes in *eminula* where the shoulder occurs in *semilunata*.

Lignitic localities.—Ala.: Gregg's landing; Woods bluff; 3 mi. s. w. of Thomasville; 4 miles above Hamilton bluff; Hatchetigbee.

Tex.: Sabinetown.

Type.—Lea collection, Acad. Nat. Sci. Phila.

Specimens figured.—Paleont. Mus., Cornell Univ.

Natica (Sigaticus) clarkeana, Pl. 11, fig. 21.

Syn. *Sigaretus* (*Sigaticus*) *clarkeanus* Ald., Jr. Cinn. Soc. Nat. Hist., July 1887, p. 83.

Sigaretus (*Sigaticus*) *clarkeanus* Ald., Bull. Am. Pal., vol. 1, p. 68, pl. 2, fig. 16, 1895.

Signatus (*Eonaticina*) *clarkeanus* Dall, Trans. Wag., etc., vol. 3, p. 380, 1893.

Aldrich's original description.—"Shell rather thick, rounded, whorls five, suture linear, surface of body whorl with a large number of impressed lines almost obsolete in the center, but numerous and distinct above and below; umbilicus striate within; aperture lunate, inner lip covered with a callus, thickening towards the posterior part. Locality: Choctaw Corner and Hatchetigbee bluff, Ala. This peculiar shell possesses the form of *Natica*, but the lines of *Sigaretus*."

This should not be referred to *Sigaretus*; its form, thick shell, umbilical features are all of *Natica*, not *Sigaretus*. The faintness of the striation on this species sometimes suggests a close relationship with some forms of *N. eminula*, which is generally more or less striate above and below. *Eonaticina* is by definition a sharp-spired, thin shell.

Localities.—Ala.: Choctaw corner; Woods bluff; 4 mi. above Hamilton bluff, Ala. river; Hatchetigbee.

Tex.: Sabinetown.

Type.—Aldrich's collection; from Choctaw corner.

Specimen figured.—Hatchetigbee; Paleont. Mus., Cornell University.

Natica eminula var. Pl. 11, fig. 22.

Syn. *N. eminula* (See Bull. Am. Pal., vol. 1, p. 233).
N. parva var., Ald., Geol. Surv. Ala., Bull. 1, p. 56.
N. decipiens Ald., Geol. Surv. Ala., Bull. 1, p. 56.
N. eminula Ald., Geol. Surv. Ala., Bull. 1, p. 58.

This form differs considerably from true *eminula* from the Claiborne sands, but its general form and appearance is such as to suggest a close relationship to the latter. *N. eminula* at Claiborne differs somewhat in its proportions, but it is generally thin, with only a slight tendency to form a columellar callosity. This form is thicker, wider in proportion to its height; with a callosity showing an indentation or notch above—a characteristic which, however, I have noticed in Jackson specimens from White bluff, Ark. These differences are probably due to difference of environment. These differential characteristics are carried slightly further in *N. marylandica* Con.; *i. e.*, *marylandica* is lower or wider than the Lignitic specimens of the South and are apt to have a larger umbilicus. *N. marylandica*, too, sometimes attains a larger size than any of its southern representatives. If *marylandica* were the older name I would be inclined to place this Lignitic form as a variety of that species, for the inter-relationship of the two is close and well marked.

It is fortunate that *eminula* and *marylandica* were proposed for the extremes of the series if the names are to be employed as denoting distinct species. But this leaves us in doubt about the proper nomenclature of these intermediate forms.

Lignitic localities.—Ala.: Woods bluff; Gregg's landing; Yellow bluff; Bell's landing; 4 mi. above Hamilton bluff; Hatchetigbee bluff; Tuscahoma landing; near mouth of Bashi creek.

Tex.: Sabinetown.

Specimen figured.—From Bell's landing; Paleont. Mus., Cornell Univ.

Natica magno-umbilicata, Pl. 11, fig. 23.

Syn. *N. magno-umbilicata* Lea, Cont. to Geol., 1833, p. 109, pl. 4, fig. 94.
N. magno-umbilicata Ald., Geol. Surv. Ala., Bull. 1, 1886, p. 51.
N. magno-umbilicata Dall, Trans. Wag., etc., vol. 3, p. 366.

Lea's original description.—"Shell subglobose, smooth; substance of the shell thin; spire depressed, rounded; suture small; columella very slightly thickened, the callus being small and reflected above the middle of the umbilicus; umbilicus very wide, grooved; whorls three, inflated, with longitudinal folds on the superior part; mouth semi-lunate, nearly three-fourths the length of the shell." Claiborne, Ala.

The Lignitic form differs very materially from the typical Clairbornian. It is larger, thicker, with a higher spire, with only traces of plications below the sutures, and no columellar callosity. It will doubtless some day be referred to a distinct species.

Lignitic localities.—Ala.: Woods bluff. Aldrich finds it also at Choctaw corner and Butler.

Type.—Academy of Natural Sciences, Philadelphia.

Specimen figured.—Paleontological Museum, Cornell University.

Natica (Neverita) onusta, Pl. 11, fig's. 24-26.

Syn. *N.* (*Polinices*) *onusta* Whitf., Am. Jr. Conch., vol. 1, p. 264, 1865.
N. onusta Ald., Geol. Surv. Ala., 1886, Bull. 1, p. 56.
N. onusta Dall, Trans. Wag., etc., vol. 3, p. 368.
N. onusta Harris, Bull. Am. Pal., vol. 1, p. 232, pl. 22, fig. 17.

Whitfield's original description.—See Bull. Am. Pal., vol. 1, p. 232.

Dall is inclined to think this is the adult form of *aperta*. He cites in favor of this idea the fact that "*N. onusta* by Whitfield, otherwise identical with his *N. aperta*, has the umbilicus plumply filled by a rounded callus. One specimen in the National Collection, among those which had been referred to as *N. aperta* Whitfield, has an incipient callus forming, and I am led to suspect that this species delays forming a callus until the shell is fully grown and then adds it, and that therefore *N. aperta* and *N. onusta* should be consolidated under the last mentioned specific name.'' Opposed to this view are the facts: that even the small *onusta* are provided with a callus; that their shell substance is thicker than in *aperta*; that there is scarcely ever a trace of a shoulder just below the suture in *onusta*, while it is strongly developed in *aperta; aperta's* spire is generally much more elevated and pointed.

This we believe to be a forerunner of *N. limula*. The latter species was recorded in Bull. 4 as coming from the Midway beds. Having up to this time seen no other specimens from so low a horizon, or even from the Lignitic, we are inclined to suspect an error in labelling somewhere. *N. onusta* varies somewhat in form, but no more than does *limula*. It is distinguished from the latter by its umbilical features only. Its umbilicus is very broadly spreading, hence giving the lower margin of the body whorl a more or less carinated appearance. The greater part of this umbilicus is filled by a callosity that has no transverse bisecting depressed line across it, as *limula* does. It is typically developed at Yellow bluff.

Localities.—Ala.: Yellow bluff; Gregg's landing; Bell's landing; Woods bluff; Nanafalia? Aldrich adds Tuscahoma.

Specimens figured.—Large depressed form, Yellow bluff; very elevated form, Gregg's landing; smaller specimen, Bell's landing. All in Paleontological Museum, Cornell University.

Natica aperta, Pl. 11, fig. 27.

Syn. *Natica* (*Girodes*) *aperta* Whitf., Am. Jr. Conch., vol. 1, p. 265, 1865.
N. aperta Ald., Geol. Surv. Ala., 1886, Bull. 1, p. 56.
N. (*Neverita*) *aperta* Dall., Trans. Wag., etc., vol. 3, p. 368.

Whitfield's original description.—''Shell very oblique, palulose; spire low; volutions three, slightly flattened on the top, with a depression just below, and sharply rounded on the lower part; umbilicus very large; upper part of the columellar lip reflected over the umbilicus; callus, none; aperture large, semi-lunate;

surface marked by lines of growth.

"*Locality.*—Six miles above Claiborne, Ala."

Localities.—Ala.: Yellow bluff; Bell's landing; Gregg's landing (the most abundant here); Lower Peach Tree, and Tuscahoma.

Type.—Hall's collection.

Specimen figured.—From Gregg's landing; Paleontological Museum, Cornell University.

Natica (Lacunaria) erecta, Pl. 11, fig. 28.

Syn. *Natica erecta* Whitfield, Am. Jr. Conch., vol. 1, p. 264, pl. 27, fig. 11, 1865.

Whitfield's original description.—"Shell subglobose; spire elevated; volutions five, ventricose; suture well marked; substance of the shell thin; aperture large, obliquely ovate; outer lip thin and sharp; columellar lip slightly thickened and grooved, without callus; umbilicus small, partly concealed by an extension of the columellar lip; surface of the shell polished.

"*Localities.*—Six miles above Claiborne, on the west side of the river, and ten miles below Prairie bluff, Ala."

Aldrich has kindly given me the specimen figured. I have recently found in our collections several specimens of this species, all from Bell's, and of a peculiar horn color.

Type.—Hall's collection.

Specimen figured.—From Bell's landing; Harris' collection.

Natica (Lacunaria) alabamiensis, Pl. 11, fig. 29.

Syn. *N.* (*Griodes*) *alabamiensis* Whitf., Am. Jr. Conch., vol. 1, p. 265, pl. 27, fig's. 9, 10, 1865.
Lacunaria alabamiensis Con., Am. Jr. Conch., vol. 2, p. 77, 1886.
Natica alabamiensis Ald., Geol. Surv. Ala., 1886, Bull. 1, p. 56.
Ampullina alabamiensis Cossm., Ann. de Geol. et. Pal., 1893, p. 26.
Natica (*Girodes*) *alabamiensis* Har., Bull. Am. Pal., vol. 1, p. 231, pl. 22, fig. 14, 1896.

Whitfield's original description.—(See this publication, vol. 1, p. 231).

Lignitic localities.—Ala.: Gregg's and Bell's landings; Tuscahoma, and Lower Peach Tree.

Specimen figured.—Gregg's; now in Paleont. Mus., Cornell Univ.

Ampullina recurva var. Pl. 12, fig. 1.

Syn. *Natica mississippiensis* Heilp., Proc. Ac. Nat. Sci. Phila., 1880, p. 365. Name in list only.
Natica mississippiensis (umbilical variety) Ald., Geol. Surv. Ala., Bull. 1, p. 56.
Natica recurva Ald., *idem*, 1886. p. 33, pl. 5, fig. 10.
Natica dumblei Heilp., Proc. Ac. Nat. Sci. Phila., 1890, p. 404, pl. 11, fig. 3.
Ampullina crassatina var. *mississippiensis* (in part) Dall, Trans. Wag., etc., vol. 3, p. 375.

Aldrich's original description.—"Shell large, globose, smooth, whorls six, spire low; suture channeled, that part of the whorl within this groove concave, rising to a shoulder. Body whorl very large, flattened on upper part, abruptly rounded below the umbilicus; aperture semilunar, rounded anteriorly and narrowed at the posterior part; callus thick, spreading over the body whorl and partially covering the umbilicus. Umbilicus large, deep, striated within, a thickened callus or rib proceeding from the lower edge of the outer lip, and rounding into the umbilicus.

"*Locality.*—Lisbon, Ala. The type shows on the body whorl traces of numerous revolving color lines."

With all of Conrad's types before me I cannot see how our Lignitic specimens can be referred to *N. mississipiensis* Con. The latter species is smooth exteriorly, showing almost no traces of growth lines; practically no umbilicus, and what there is, is obliterated by the labial callosity; no sign of the "thickened callus or rib proceeding from the lower edge of the outer lip and rounding into the umbilicus," as mentioned under *recurva*.

The Lignitic variety of *recurva* is generally smaller than the type specimen. The "rib" just referred to does not generally make quite so wide a sweep, but proceeds more directly up into the umbilicus in the varietal form. *N. recurva* varies greatly at its type locality so far as suture channeling and height of spire are concerned.

Lignitic localities.—Ala.: Hatchetigbee; Woods bluff; Bell's landing; Yellow bluff. Gregg's landing also.—Aldrich.

Variety figured.—From Hatchetigbee; Lea Memorial Collection.

Sigaretus declivus, Pl. 11, fig. 30.

Syn. *S. declivus* Con., Foss. Sh. Tert., etc., Nov. 1833, p. 45.
Natica striata (in part) of Lea, Cont. to Geol., Dec. 1833, p. 105, pl. 4, fig. 88.
Catinus bilix var. *diclivus* Con., Am. Jr. Conch., vol. 6, p. 314, pl. 13, fig. 2, 1870.
S. declivus Dall, Trans. Wag., etc., vol. 3, p. 378.

Conrad's original description.—"Obliquely suboval, with distinct impressed and intermediate fine striæ; spire slightly prominent; umbilicus small, partly closed by the callus; aperture patulous." Claiborne, Ala.

Lignitic localities.—Ala.: Woods bluff; Bell's landing; Gregg's landing.

Type.—Acad. Nat. Sci., Phila.

Specimen figured.—Woods bluff; Paleont. Mus., Cornell Univ.

Sigaretus bilix, Pl. 11, fig. 31.

Syn. *S. bilix* Con., Am. Jr. Sci., vol. 23, p. 344, Jan. 1833.
Natica striata Lea, Cont. to Geol., Dec. 1833, p .105.
Catinus bilix Con., Am. Jr. Conch., vol. 6, p. 314, pl. 13, fig. 4, 1870.
Sigaretus bilix Dall, Trans. Wag., etc., p. 378 of vol. 3.

Conrad's original description.—"Shell obliquely oval, convex, with fine crowded striæ revolving in pairs. Length, one-third of an inch.

"*Locality.*—Claiborne, Ala. *London Clay.*"

So far as our observation goes Dall is correct in retaining both names *bilix* and *declivus* as of specific rank. Lea, and afterwards Conrad, referred the two to the same species, though Conrad still retained *declivus* as a varietal designation. *Bilix* is rotund; *declivus* is oblique. So far we have had no trouble in separating the two species.

Lignitic locality.—Ala.: Woods bluff. Aldrich adds Choctaw corner and Butler.

Type.—Acad. Nat. Sci., Phila.

Specimen figured.—Woods bluff; Paleont. Mus., Cornell Univ.

Adeorbis liniferus, Pl. 12, fig. 2.

Syn. *Solariorbis subangulatus* (Mr. var.) Ald., Bull. Am. Pal., vol. 2, p. 172, pl. 5, fig. 8, 1897.
S. liniferus Ald., *idem.*

Aldrich (*loc. cit.*) says of this "*subangulatus*" var.: "Shell small, depressed, whorls five, rapidly increasing in size; surface covered with fine revolving lines, umbilicus deep; aperture approaching quadrate, suture distinct.

"This agrees with Meyer's description and figure. If new, however, it may be called *S. liniferus.* Type [of *subangulatus*] was obtained at Jackson, Miss."

(See *Teinostoma subangulata.*)

Locality.—Ala.: Choctaw corner.

Type of liniferus.—Aldrich's collection.

Adeorbis sylværupis n. sp. Pl. 12, fig's. 3, 4.

Specific characterization.—Size and general features as indicated by the figures; whorls about five; surface depressed just exterior to the suture; spiral lines, raised, sharp, increasing in strength from suture to the peripheral, the eighth line, which carinates the whorl; below a sub-carina and between it and the umbilicus three more small spirals; umbilicus large, smooth. Between the carinal and sub-carinal lines there is generally a more or less conspicuous revolving line, though no trace of it is to be seen on the type specimen.

Differs from *A. exacuus* Con. by (1) the presence of two raised spirals in the subsutural depression in place of a large number of fine hair lines, (2) the entire absence of hair line spirals between the high raised lines, by (3) the lack of the broad, flattened base of the body whorl of *exacuus*, (4) the presence of three well-developed spirals and a sub-carina beneath.

In general appearance this is like *A. delphinuloides* Mr., though that has the striation af *exacuus*.

Locality.—Ala.: Woods bluff. Var. fig's. 4, 4 a, from Hatchetigbee.

Type and specimen figured.—Paleont. Mus., Cornell Univ.

Varietal form.—Lea Memorial collection, Phila. Acad.

Adeorbis dalli n. sp. Pl. 12, fig. 5, a.

Specific characterization.—Size and general form as indicated by the figures; spire low; suture distinct and with a depression immediately without; mouth nearly circular, very slightly angular at the termination of a faint ridge separating the umbilicus from the remainder of the body whorl; umbilicus very broad; the whorls all plainly visible from below. The surface is striate, as indicated by the figure.

This was at first taken for Lea's "*Turbo lineata*," but it is much smaller, much more depressed, and with an enormous umbilicus, quite different from Lea's species.

Locality.—Ala.: Woods bluff.

Type and specimen figured.—Paleont. Mus., Cornell Univ.

Scala, Pl. 12, fig. 6.

The Eocene *Scalæ* are in a somewhat confused state and I accordingly hesitate to name mere fragments like this, though it is evidently very distinct from the other two species figured.

Localities.—Ala.: Yellow bluff.
Tex.: Sabinetown.

Specimen figured.—Lea Memorial collection.

Scala exquisita, Pl. 12, fig's. 7, 7 a.

Syn. *S. exquisita* Ald., Bull. Am. Pal., vol. 2, p. 180, pl. 2, fig's. 7, 7 a.

For Aldrich's description, see the above reference.

Locality.—Gregg's landing, Ala.

Figures.—Same as in vol. 2, pl. 2.

Scala, Pl. 12, fig. 8.

Immature specimen from Woods bluff, showing features very distinct from the others, though too immature for certain identification. In the Paleontological Museum, Cornell University.

Mathilda leana, Pl. 12, fig. 9.

Syn. *Tuba* (*M.*) *leana* Ald., Bull. Am. Pal., vol. 2, p. 180, pl. 2, fig. 2.

For Aldrich's description, see the above reference.

Locality.—Choctaw corner.

Figure.—Same as in vol. 2, etc.

Turbonilla, sp. Pl. 12, fig. 10.

I have but one specimen of this species and that is very small and apparently eroded, so I defer referring it to any known species or describing it as a new one. It is from Bell's landing, Ala.

Specimen figured.—Paleont. Mus., Cornell Univ.

Eulima (Subularia) cainei n. sp. Pl. 12, fig. 11, a.

Specific characterization.—Size and general form as indicated by the figures; whorls nine, the upper four with well-marked suture; below, however, the suture is not sharply and definitely incised; mouth long, narrow, outer lip sinuous; columella with a callus extending nearly its whole length; body whorl angular medially, other whorls straight-sided.

Resembles most closely *Eulima fusus* Dall, a recent shell of the S. E. coast of the U. S.

Locality.—Ala.: Woods bluff.

Tyre.—Paleont. Mus., Cornell Univ.

Eulima exilis, Pl. 12, fig. 12.

Syn. ? *Pasithea lugubris* Lea, Cont., etc., 1833, p. 101, pl. 4, fig. 81.
E. exilis Gabb, Jr. Acad. Nat. Sci. Phila., vol. 4, p. 385, pl. 67, fig. 43, 1860.

Gabb's original description.—"Elongate slender, polished; whorls eight; apex acuminate, mouth small, outer lip nearly straight. Dimensions: Length, .23 in.; width of body whorl, .05 in.; length of mouth, .05 in." From Caldwell, Texas.

The broken specimen now in the Philadelphia Academy's collection, supposed to be the type, does not agree in all respects with Gabb's figure and description. I am not sure of the present identification, having only the imperfect specimen figured.

Specimen figured.—Woods bluff, Ala. Now in Paleont. Mus., Cornell Univ.

Niso umbilicata, Pl. 12, fig. 13.

Syn. *Pasithea umbilicata* Lea, Cont. to Geol., 1833, p. 103, pl. 4, fig. 85.
Niso umbilicata D'Orb., Prod. 2, p. 318, t. 92.
(*Bonellia lineata* Con., Jr. Phila. Ac., 1st. Ser.. vol. 8, though referred to *umbilicata* Lea by Con., Am. Jr. Conch., vol. 1, p. 29, is doubtless very distinct, presumably from the Miocene of Maryland.)
Niso umbilicata de Greg., Mon. Faun. Eoc. Ala., 1890, p. 162, pl. 16, fig's. 7, 8.

Lea's original description.—"Shell elevated above, rounded below, sub-carinate, polished; substance of the shell thin; apex acute; suture linear; umbilicus large; whorls nine, flattened; mouth subovate, acutely angular above, one-fifth the length of the shell; columella incurved at base; margin entire. Length, .2 in.; breadth, .1 in. * * * Its umbilicus is wide, with a large spiral groove. On some of the whorls the line of growth may be indistinctly seen."

Lea's specimen was small and imperfect. The "spiral groove" does not seem to occur in our Claiborne specimens, but high up in the umbilicus there is sometimes a longitudinal plaiting.

Lignitic localities.—Ala.: Woods bluff; Yellow bluff.

Specimen figured.—From Woods bluff; Paleont. Mus., Cornell Univ.

Type.—Lea collection, Phila. From Claiborne.

Eulimella tenua, Pl. 12, fig. 16.

Syn. *Eulima tenua* Gabb, Jr. Ac. Nat. Sci. Phila., vol. 4, p. 386, pl. 67, fig. 45, 1860.

Gabb's description.—"Very elongated and narrow; whorls nine, rounded; suture distinct; mouth very small, oval.

"Dimensions.—Length, .15 in.; width of body whorl, .025 in.; length of mouth, .02 in.

"*Locality.*—Caldwell, Tex."

The type now in the Phila. Acad. I have figured and it will be given in the forthcoming bulletin on the Lower Claiborne fossils. Specimens from the Lignitic of Alabama show a very faint trace of a fold near the top of the straight columella.

Lignitic locality.—Ala.: Woods bluff.

Specimen figured.—Paleont. Mus., Cornell Univ.

Syrnola dalli var. Pl. 12, fig. 14.

Syn. ? *Obeliscus perexilis* Con., Am. Jr. Conch., vol. 1, pp. 144, 211, pl. 20, fig. 2, 1865.
Syrnola dalli Coss., Ann. de Geol. and Pal., 1893, p. 22, pl. 1, fig. 28.

Cossmann's original description.—"Testa angusta, multispirata, lævigata, anfractibus parum elevatis; sutura profunda discretis; ultimo ad basim valde rotundato; apertura parva; columella biplicata.

"Petite coquille étroite, allongée, composée d'un grand nombre de tours étroits et lisses, que séparent des sutures profondément gravées, mais non canaliculées; le dernier n'est pas grand, et est arrondi et très convexe à la base, sans aucune trace d'ombilic; overture petite, rhomboïdale, columella armée de deux plis presque égaux, un peu obliques et saillants."

I do not feel altogether sure of the specific difference between *perexilis* Con. and *dalli* Cassman. Regarding a very similar form I found in the Lower Claiborne of Texas, I wrote in my still unpublished report: "By examining a large number of specimens from Claiborne it will be observed that some show signs of a rudimentary plait below the strong one noted by Conrad. This feature is noticeable in the Texas specimen."

Cassmann says the plaits in *dalli* are almost equal. Again, the suture as figured by him are not the same as in our specimen. Yet both most probably belong to the same species.

Lignitic locality.—Ala.: Woods bluff.

Type.—Cossmann's collection.

Specimen figured.—Paleont. Mus., Cornell Univ.

Syrnola trapaquara, Pl. 12, fig. 15.

Syn. *? S. propeacicula* Coss., Ann. Geol. et Pal., 1893, p. 23, pl. 1, fig. 29.
S. trapaquara Har., Proc. Ac. Nat. Sci. Phila., 1895, p. 77, pl. 8, fig. 10.
Odontostomia insignifica Ald., Bull. Am. Pal., vol. 2, p. 179, pl. 2, fig. 8, 1897.

Harris' original description.—"Size and general form as indicated by the figure; whorls seven; 1 small, sinistral; 2-7 polished, slightly tumid, with a well-marked suture; aperture moderate, striate within; one strong plait on the columella."

Described from Lower Claiborne beds in Texas.

I regard *insignifica* as exactly synonymous with *trapaquara*. *S. propeacicula* is, however, quite a different form, if the figure Cossmann gives is exact. But from some points made in the description I am somewhat inclined to think the figure not entirely true to nature. Hence the doubt expressed in the synonymy.

Lignitic localities.—Ala.: Woods bluff; Gregg's landing.

Type.—Texas State Museum.

Liotia granulata, Pl. 12, fig. 17.

Syn. *Solarium granulatum* Lea, Cont. to Geol., 1833, p. 122, pl. 4, fig. 111.
S. tricostatum Con., Foss. Sh. Tert. Form., 1835, p. 50, pl. 17, fig. 10.
S. granulatum Ald., Geol. Surv. Ala., Bull. 1, 1886, p. 50.
L. (*Solarium*) *granulata* Dall, Trans. Wag., etc., vol. 4, p. 411.

Lea's original description.—"Shell conical, flattened below, with seven or eight transverse granulate lines, between which it is furnished with oblique striæ; substance of the shell thick, suture furrowed; umbilicus narrow, largely crenate without, striate within; whorls five; mouth nearly round, subangular above; outer lip crenate. Length .2, breadth .2 of an inch." Described from Claiborne, Ala.

The best Lignitic specimen we have is from Woods bluff, and is shown by the figure. It varies slightly from the Claiborne type in having a little more prominent granules above, but not quite so prominent near the umbilicus. The shell is thick and shows distinctly where the operculum fitted in. Also at Hatchetigbee.

Type.—Acad. Nat. Sci. Phila. Lea collection.

Solariella louisiana, Pl. 12, fig. 18.

Syn. *Solarium elegans* var. Ald., Geol. Surv. Ala., Bull. 1, 1886, pp. 50, 51.
S. louisiana Dall, Trans. Wag., etc., vol. 3, p. 407, 1893.
S. sylværupis Har., Proc. Ac. Nat. Sci. Phila., 1896, p. 477.
S. louisiana Dall, Trans. Wag., etc., vol. 3, pl. 23, fig's. 1, 1 a, 1898.

Dall's original description.—"Shell small, subconical, with five or six whorls; nucleus small; whorls rounded, with a flattened space in front of the suture, which is distinct and sometimes even slightly channeled; the flattened area is bounded anteriorly by an elevated spiral thread, which especially on the earlier whorls is more or less distinctly beaded; besides this the surface is sculptured with spiral grooves separated by about equal interspaces and crossed obliquely by numerous impressed lines, rather evenly spaced and in harmony with the lines of growth; the sculpture throughout is stronger on the upper part of the whorls and on the earlier whorls; on the last whorl it is more or less obsolete in nearly all the specimens; the periphery is evenly rounded; the base slightly flattened; the umbilicus large and funicular, its walls sculptured in both directions, the spirals distinctly beaded; the umbilical carina is crenate, with a narrow sulcus formed by two or three impressed lines, outside of the carina; aperture very oblique, rounded, thin-edged, hardly interrupted by the body whorl or umbilical carina. Altitude of two specimens, A and B, A 7, B 5.5; max. diam., A 8.5, B 7.00 mm.

"This species has been generally confounded with *S. elegans*, which is a less elevated shell, with a scalar umbilicus and generally with several elevated, rather distant spirals and more prominent sculpture."

The shell is beautifully nacreous just beneath the surface layers, which are often more or less exfoliated. When young the line just outside of the umbilical carina is very deep and wide; just outside of this furrow there is a second deeply-beaded band separated from the rest of the base of the whorl by a second but less deeply incised line. In young specimens the umbilical carina projects downward far below the peripheral margin of the body whorl.

I overlooked Dall's description (without figure) of this species given in his "Tertiary Fauna of Florida" and gave another name, *sylværupis*. In part IV. of Dall's work, just published (1898), I find it figured. It is true that a fossil is not now entitled to a name in scientific literature until it is figured. But inasmuch as Dall refers to a plate and figure in his earlier work, this is taken as proof that a figure was drawn then, though published in 1898. Courtesy would doubtless therefore permit the use of the name *S. louisiana*.

Lignitic localities.—Ala.: Hatchetigbee; Woods bluff; 4 mi. above Hamilton bluff.

Type.—National Museum.

Specimen figured.—Lea Memorial Collection, Acad. Nat. Sci., Phila.

Cyclostrema aldrichi, n. sp. Pl. 12, fig's. 19, a.

Specific characterization.—Size and general form as indicated by the figures; the spire depressed, though not so concave as the under or umbilical side of the shell; costæ somewhat irregularly placed and at their junction with the spirals becoming somewhat nodular, especially on the uppermost and lowermost portions of the body whorl; the latter very slightly carinated above.

Types and specimens figured.—Ala.: Woods bluff. Paleont. Mus., Cornell Univ.

Teinostoma subangulatus, Pl. 12, fig's. 20-22.

Syn. ? *Adeorbis subangulatus* Meyer, Bull. 1, Geol. Surv. Ala., 1886, p. 67, pl. 2, fig. 28.

Meyer described his *A. subangulatus* from Jackson, Miss., as follows: "Discoid; whorls five, rapidly increasing in size; margin somewhat angular; basal part of margin rounded; umbilicus deep; suture distinct; surface with revolving lines, indistinct near the margin; aperture irregularly elliptical.

"*Adeorbis depressus* Lea sp. (*Teinostoma rotula* Heilpr.) from Claiborne has the umbilicus nearly closed, a regularly rounded margin, a more developed ornamentation, and is larger."

Having just examined the type of *rotula* kindly sent me from the Am. Mus. Nat. Hist., I am inclined to think it an extremely smooth variety of *depressa*, for its umbilical rib is the same and on the base near the aperture there are traces of spiral punctuate lines.

Not having the type of *subangulatus* for comparison, it is with great doubt that these Lignitic forms are referred to Meyer's species. Instead of being smaller than *depressus* they are in some instances of two or three times the dimensions of that species. They vary greatly in angulation or carination of the body whorl. They are generally rather finely striate or smooth above and more strongly striate below. There is a thickening of the middle portion of the obliquely-cut columella, but no distinct umbilical rib as seen in species like *depressus* The Lea Memorial specimen from Bell's (fig. 20) is flattened and smooth above; our Gregg's landing specimen (fig's. 21, a) is more bicarinate, with higher spire and striate above and below; the Sabinetown fragment (fig's. 22, a, b) is more callous about its umbilicus and is smooth and shining all over.

Aldrich's "*Adeorbis depressus* Lea" and "*Teinostoma subrotunda* Mr.," from Bell's landing (Bull. 1, Geol. Surv. Ala., p. 87), come in near here somewhere.

Fissurella alabama, n. sp. Pl. 12, fig's. 23, a.

Specific characterization.—Size and general appearance as figured; low; marked exteriorly by about eighteen primary radii, between which there are two or three secondary and sometimes an equal number of tertiaries. Concentric striæ strong, raised, causing folds or granulations at their intersections with the strong ribs.

Locality.—Ala.: Gregg's landing.

Type and specimen figured.—Lea Memorial Collection; Phila. Acad. Nat. Sci.

Pteropoda.

Spirialis choctavensis, Pl. 12, fig. 24.

Syn. *Physa choctavensis* Ald., Jr. Cinn. Soc. Nat. Hist., July 1887, p. 83.
Spirialis choctavensis Ald., Bull. Am. Pal., vol. 1, p. 57, pl. 3, fig. 10, 1895.

Aldrich's original description.—"Shell thin, minute, rather obtuse and broad, whorls probably five, somewhat shouldered, outer lip slightly patulous, inner lip reflected and reaching well upon the body wall, surface showing lines of growth only.

"*Locality.*—Choctaw corner, Ala., Woods bluff group.

"Resembles somewhat very young specimens of the common *Physa heterostropha* Say., but presenting differences enough to constitute a distinct species.

"Five specimens found."

The specimen figured is in the Cornell Univ. Paleont. Mus., from Woods bluff.

Spirialis elongatoidea, Pl. 12, fig. 25.

Syn. *Physa elongatoidea* Ald., Jr. Cinn. Soc. Nat. Hist., July 1887, p. 83.
Spirialis elongatoidea Ald., Bull. Am. Pal., vol. 1, p. 57, pl. 3, fig. 9, 1895.

Aldrich's original description.—"Shell thin, minute, strongly sinistral, whorls five, smooth, suture strongly impressed and very oblique to the axis, aperture almost quadrate, inner lip meeting the parietal wall abruptly and reaching down nearly straight. Locality same as previous species. This form is peculiar in departing from the American living types and being more elongate than any here known. It might be mistaken for a species of *Limnea* if it was not sinistral. The only specimen found is a young shell."

No specimens have been found in our collections. The figure is of Aldrich's type.

Cephalopoda.

Nautilus fragment, Pl. 12, fig. 26.

From Woods bluff, Ala.

Plate I.

EXPLANATION OF PLATE 1.

(1)

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Fig.	1.	*Dentalium microstria* Heilp	3,	**3**
	2.	*Dentalium multannulatum* Ald	4,	**4**
	3.	*Cadulus abruptus* Ald. and Mr	5,	**5**
	4.	*Actæon idoneus* Con	5,	**5**
	5.	"*Actæon*" *cossmanni* Ald	6,	**6**
	6.	*Tornatellæa bella* Con	6,	**6**
	7.	*Volvaria* (*Volvariella*) *alabamiensis* Ald	7,	**7**
	8.	*Tornatina leai* Ald	7,	**7**
	9.	*Scaphander alabamiensis* Ald	7,	**7**
	10.	*Scaphander ligniticus* Ald	8,	**8**
	11.	*Atys robustoides* Ald	8,	**8**
	12.	*Cylichna sylværupis*, n. sp	8,	**8**
	13.	*Cylichna aldrichi* Lang	9,	**9**
	14.	*Ringicula butleriana* var. *lignitifera* Ald	9,	**9**
	15.	*Ringicula butleriana* Ald	10,	**10**
	16.	*Philene alabamensis* Ald	10,	**10**
	17a.	*Umbrella sylværupis*, n. sp	10,	**10**
	18.	*Pleurotoma mediavia*, var	11,	**11**
	19.	*Pl. mediavia* var. *equiseta*, n. var	11,	**11**
	20.	*Pleurotoma moniliata* Heilp	11,	**11**
	21.	*Pleurotoma denticula*, var	12,	**12**
	22.	*Pleurotoma denticula*, var	12,	**12**

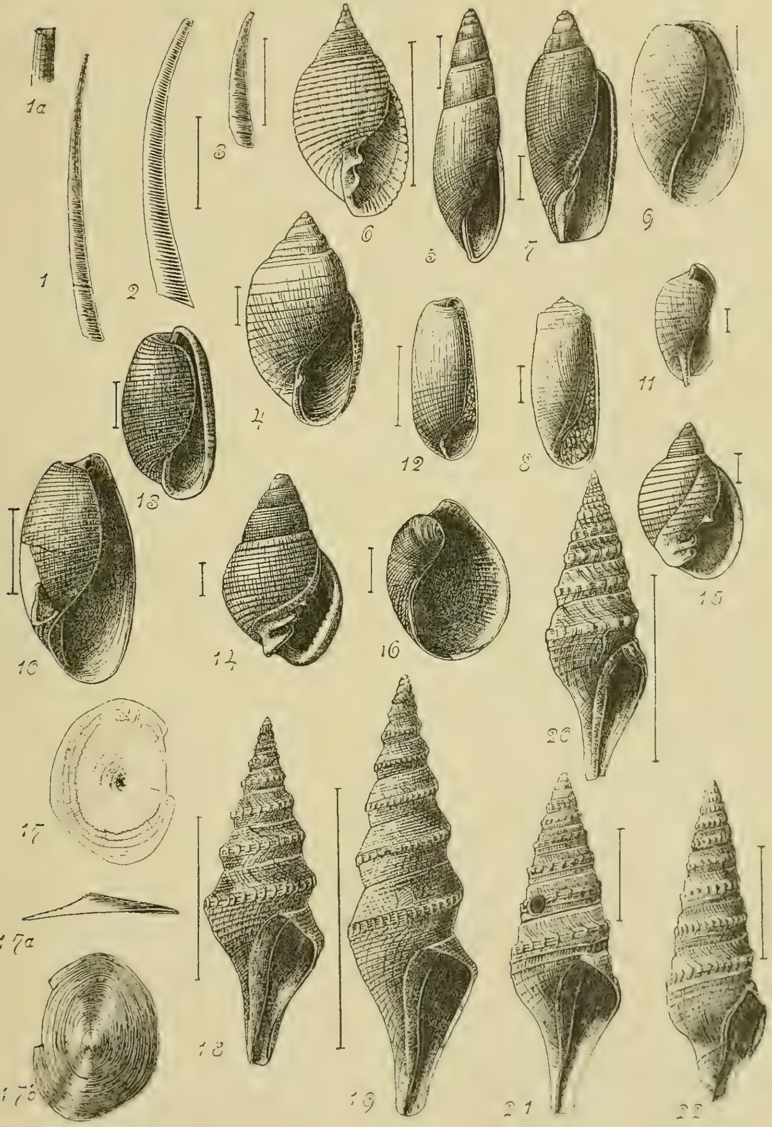
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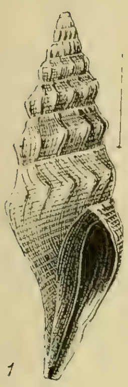
Plate 2.

EXPLANATION OF PLATE 2.

(2)

		Page.
Fig. 1.	*Pleurotana nebulosa*, n. sp.	13, **13**
2.	*Pl. vaughani*, var. *sylværupis*, n. var. x 0.80	14, **14**
3.	*Pleurotoma servatoidea* Ald	15, **15**
4.	*Pleurotoma servatoidea* (young)	15, **15**
5.	*Pleurotoma moorei* Gabb	16, **16**
6.	*Pleurotoma langdoni* Ald	17, **17**
7.	*Pleurotoma roscoei*, n. sp.	17, **17**
8.	*Pleurotoma exilloides* Ald	18, **18**
9.	*Pleurotoma capax* Whitf	18, **18**
10.	*Pleurotoma* (?) *siphus* Ald	19, **19**
11.	*Pleurotoma terebralis* Lam	19, **19**
12,a.	*Pleurotoma tombigbeensis* Ald	20, **20**
13.	*Pleurotoma silicata* Ald	21, **21**
14.	*Pleurotoma nasuta*, var. Whitf	21, **21**
15.	*Pleurotoma nasuta* Whitf., x 0.80	21, **21**
16.	*Pleurotoma cainei*, n. sp.	22, **22**
14.	*Pleurotoma georgei*, n. sp.	22, **22**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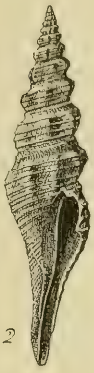
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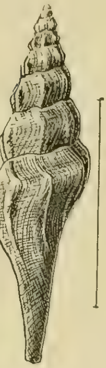
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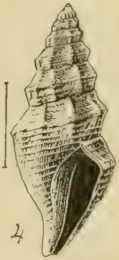
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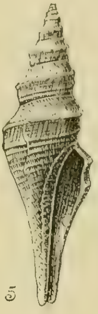
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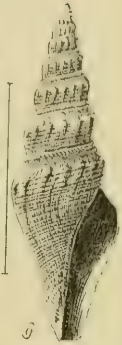
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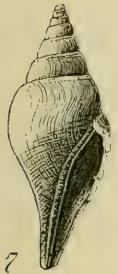
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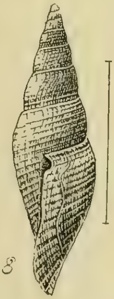
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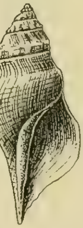
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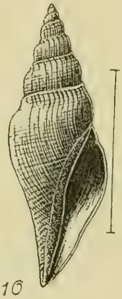
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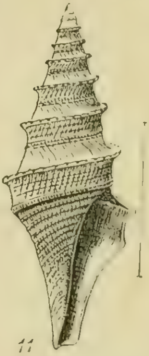
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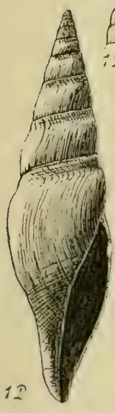
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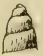
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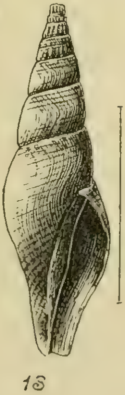
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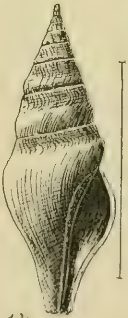
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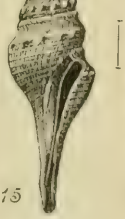
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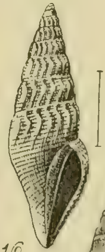
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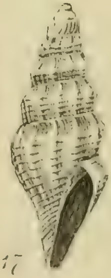
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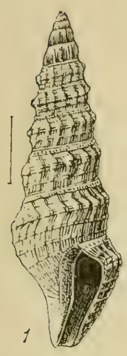
Plate 3.

EXPLANATION OF PLATE 3.

(3)

			Page.
Fig.	1.	*Pleurotoma carlottæ*, n. sp.	23, **23**
	2.	*Pleurotomella sigma*, n. sp.	23, **23**
	3.	*Pl.* (*Mangilia*) *infans*	24, **24**
	4.	*Pleurotoma veatchi*, n. sp.	25, **25**
	5.	*Cancellaria sylværupis* Har., x 0.80	25, **25**
	6.	*Cancellaria quercollis*, var. *greggi*, n. var.	26, **26**
	7.	*Cancellaria tortiplica* Con., x 2.40	26, **26**
	8.	*Cancellaria lanceolata* Ald.	27, **27**
	9.	*Cancellaria marieana* Ald. (after Aldrich)	28, **28**
	10.	*C. graciloides*, var. *bella* Ald. (Height, 10 mm.) (Aldrich's figure)	29, **29**
	11.	*Cancellaria graciloides* Ald. (Height, 12 mm.) (Aldrich's figure)	29, **29**
	12.	*Olivella mediavia* Har.	29, **29**
	13.	*Ancillaria staminea* Con.	30, **30**
	14.	*Buccinanops ellipticum* Whitf. (Back)	30, **30**
	15.	*Buccinanops ellipticum* Whitf. (Front)	30, **30**
	16.	*Pseudoliva vetusta* Con., x 0.80	31, **31**
	17.	*Pseudoliva tuberculifera* Con.	32, **32**
	18.	*Pseudoliva scalina* Heilp. (about ½ nat. size)	32, **32**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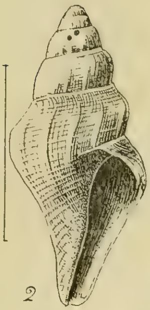
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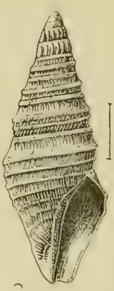
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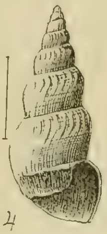
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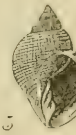
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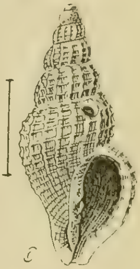
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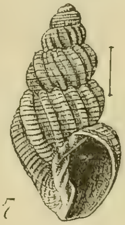
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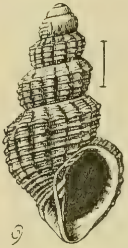
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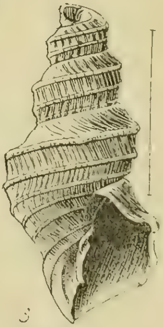
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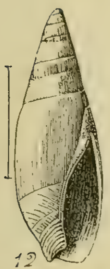
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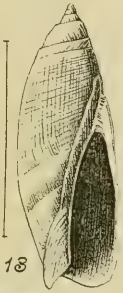
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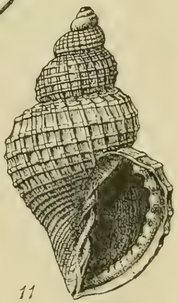
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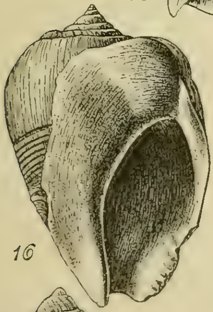
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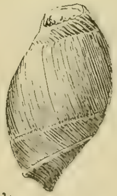
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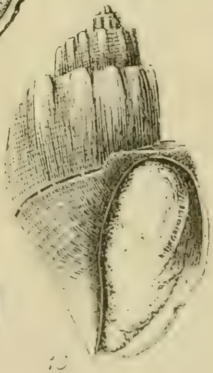
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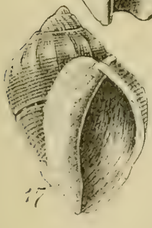
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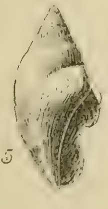
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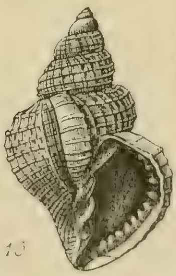
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Plate 4.

EXPLANATION OF PLATE 4.

(4)

			Page.
Fig.	1.	*Volutilithes petrosus* Con.	33, **33**
	2.	*Voluca claræ*, n. sp.	34, **34**
	3.	*Voluta*, sp.	35, **35**
	4,a.	*Voluta newcombiana* Whitf.	35, **35**
	5.	*Scaphella heilprini* Dall.	36, **36**
	6.	*Scaphella demissa*, var. Con.	36, **36**
	7.	*Scaphella demissa*, var. Con.	36, **36**
	8.	*Caricella podagrina* Dall, x 0.80.	37, **37**
	9.	*Conomitra tracyi*, n. sp.	38, **38**
	10.	*Mitra perexilis* Con.	39, **39**
	11.	*Mitra hatchetigbeensis* Ald.	39, **39**

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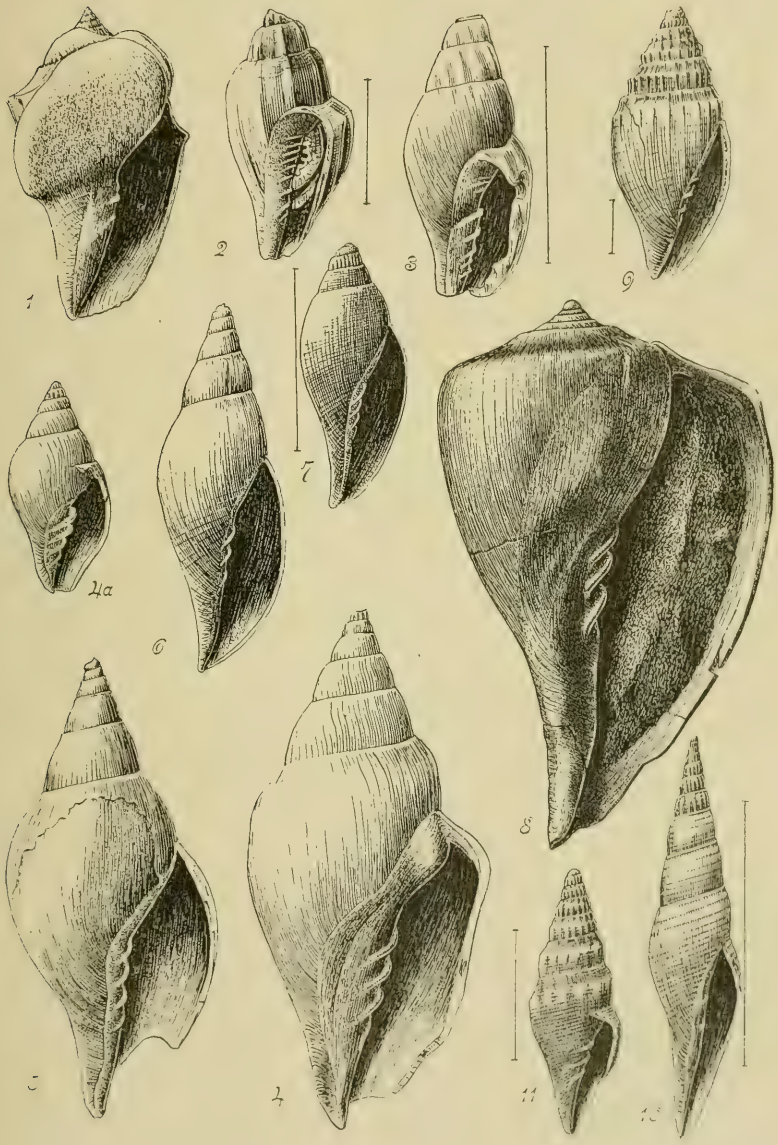
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Plate 5.

EXPLANATION OF PLATE 5.

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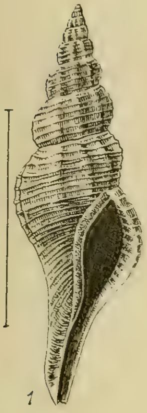
			Page.
Fig.	1.	*Fusus interstriatus* Heilp.	40, **40**
	2.	*Fusus interstriatus* Heilp., var.	40, **40**
	3.	*Fusus bellanus* Har., x 0.80	41, **41**
	4.	*Fusus subtenuis* Heilp.	42, **42**
	5.	*Fusus ottonis* Ald.	42, **42**
	6.	*Fusus rugatus* Ald., x 0.80	43, **43**
	7.	*F.* (*Buccinofusus*) *harrisi* Ald.	43, **43**
	8.	*Clavilithes kennedyanus*, var. Har.	44, **44**
	9.	*Latirus tortilis*, var. *nanafalius*, nov. var.	45, **45**
	10.	*Siphonalia*, sp. (Yellow bluff form)	45, **45**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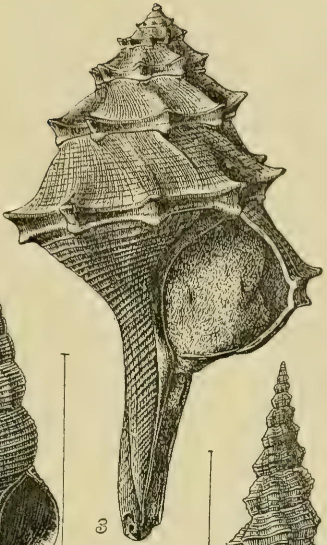
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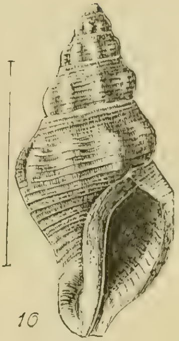
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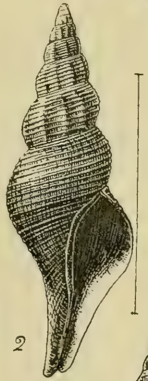
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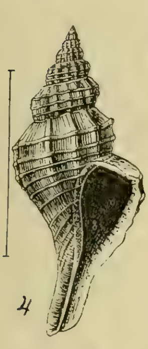
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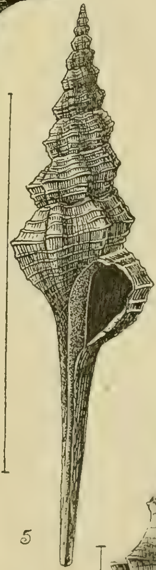
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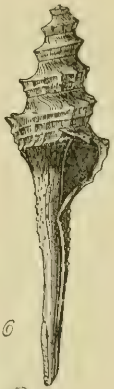
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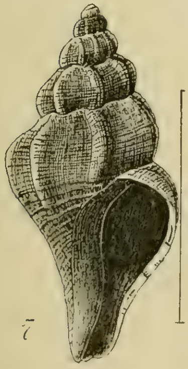
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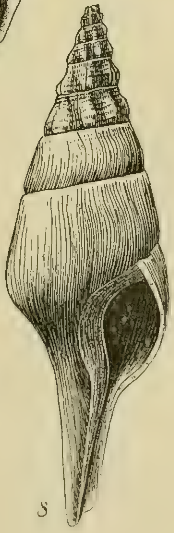
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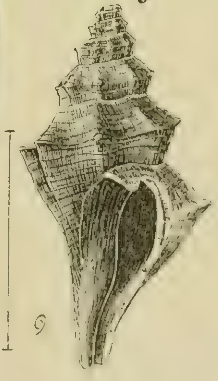
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Plate 6.

EXPLANATION OF PLATE 6.

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			Page.
Fig.	1.	*Siphonalia*, sp.	45, **45**
	2.	*Turbinella* (*Glyptostyla ?*) *baculus* Ald.	46, **46**
	3.	*Pyropsis perula* Ald., x 0.80	46, **46**
	4.	*Chrysodomus engonata* Heilp.	47, **47**
	5.	*Sipho tuomeyi* Ald.	48, **48**
	6.	*Chrysodomus striata* Ald.	48, **48**
	7.	*Siphonalia subscalarina* Heilp.	49, **49**
	8.	*Levifusus trabeatus* Con., x 0.80	50, **50**
	9.	*Levifusus supraplanus*, n. sp.	50, **50**
	10.	*Levifusus pagoda* Heilp., (Aldrich's figure)	51, **51**
	11.	*Cylene bellana* Har., x 1.60	52, **52**
	12.	*Levibuccinum lineatum* Con.	52, **52**

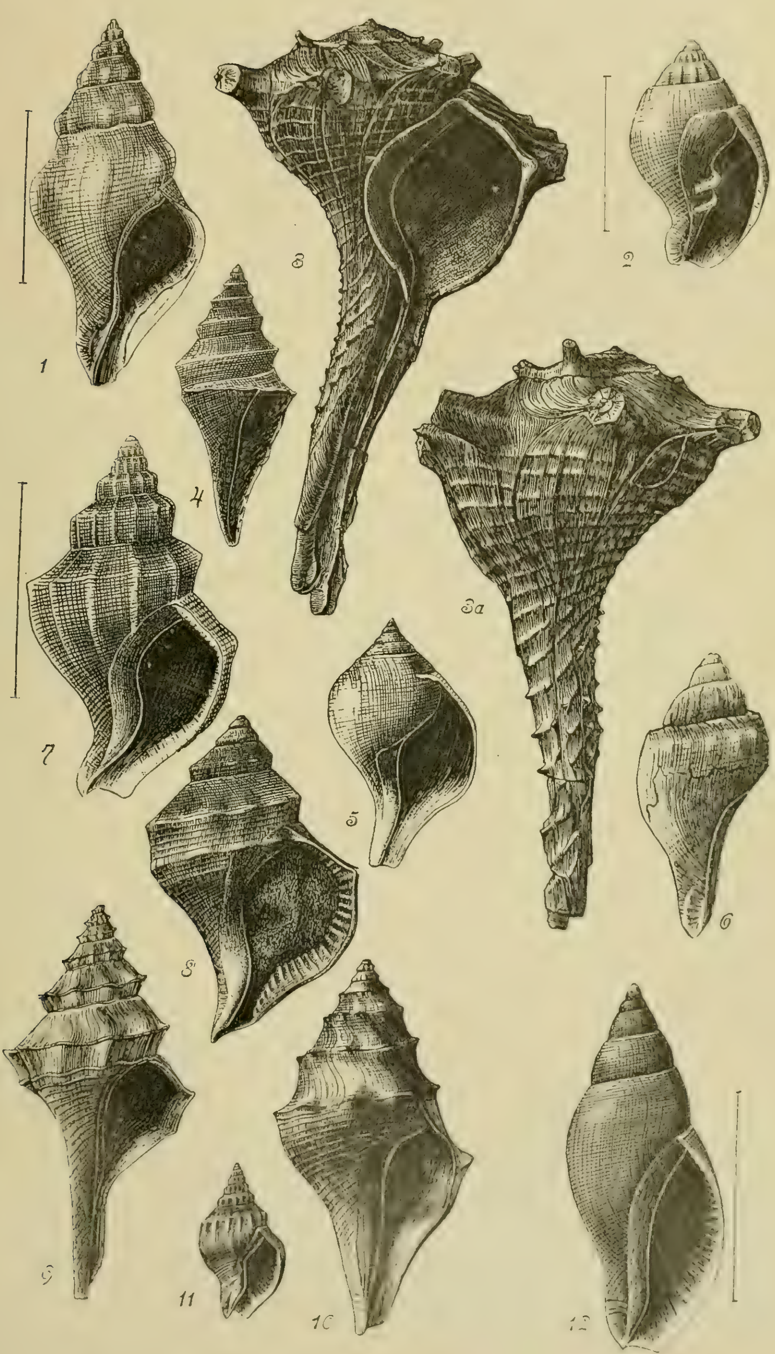
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Plate 7.

EXPLANATION OF PLATE 7.

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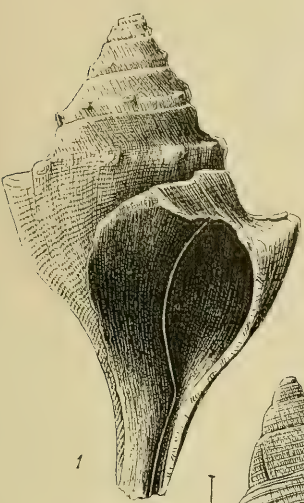
			Page.
Fig.	1.	*Levifusus indentus*, n. sp	52, **52**
	2.	"*Sipho erectus*" Har., x 0.80	59, **59**
	3.	*Triumphis hatchetigbeensis* Ald.	53, **53**
	4.	*Tritonidea johnsoni* Ald.	54, **54**
	5.	*Mazzalina* var. *plena* Ald.	54, **54**
	6.	*Euthria dubia* Ald.	55, **55**
	7.	*Metula sylværupis*, n. sp	56, **56**
	8.	*Macron philadelphicus*, n. sp	56, **56**
	9.	*Nassa exilis* Con.	57, **57**
	10.	*Bulliopsis choctavensis* Ald.	58, **58**
	11.	*Astyris subfraxa*, n. sp	58, **58**
	12.	*Æsopus erectus* Ald.	59, **59**
	13.	*Terebrifusus amœnus* Con.	59, **59**
	14.	*Mitrella mississippiensis* Ald. and Mr.	60, **60**
	15.	*Mitrella alabamiensis* Ald.	60, **60**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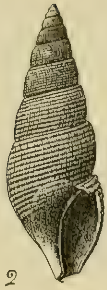
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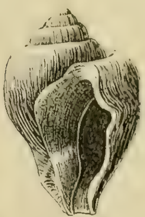
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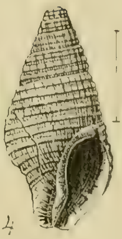
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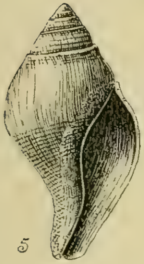
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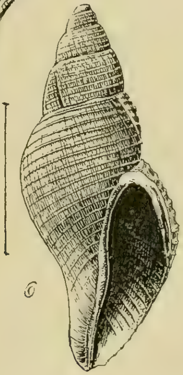
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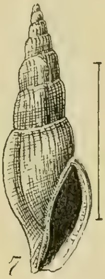
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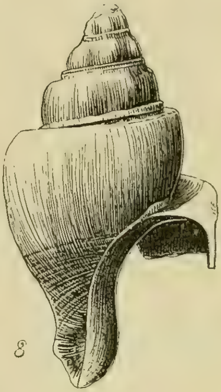
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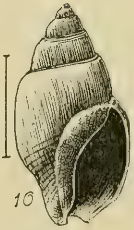
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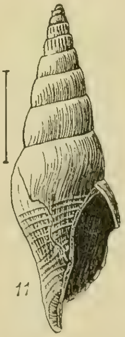
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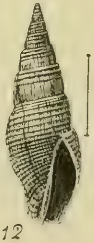
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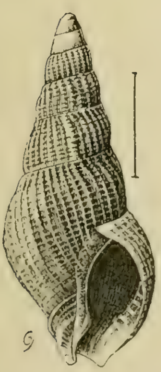
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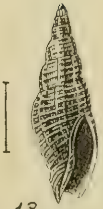
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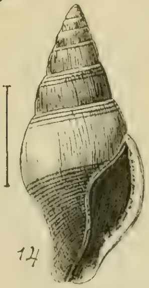
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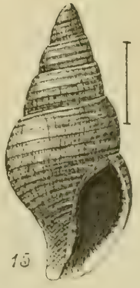
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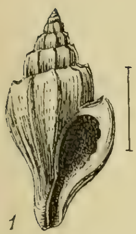
Plate 8.

EXPLANATION OF PLATE 8.

(8)

		Page.
Fig. 1.	*Trophon sublevis*, n. sp.	61, **61**
2.	*Trophon caudatoides* Ald.	61, **61**
3 & 6.	*Trophon elegantissimus* Ald.	62, **62**
4.	*Trophon gracilis* Ald.	62, **62**
5.	*Muricidea imbricatula* Har., x 0.80	62, **62**
7.	*Phyllonotus morulus* Con., x 0.80	63, **63**
8.	*Cornulina armigera* Con. (with but one row of spines)	63, **63**
9.	*Cornulina armigera* Con. (with three rows of spines)	63, **63**
10.	*Cornulina armigera* Con. (one strong, one incipient row of spines)	63, **63**
11.	*Cornulina armigera* Con. (base, enlarged)	63, **63**
12.	*Triton tuomeyi* Ald.	64, **64**
13.	*Triton* (*Ranularia*) *eocensis* Ald., x 0.80	65, **65**
14.	*Triton* (*Epidromus*) *otopsis* Con.	65, **65**
15.	*Fusoficula juvenis* Whitf. (with one row of tubercles)	66, **66**
16.	*Fusoficula juvenis* Whitf. (with four rows of tubercles)	67, **67**
17.	*Fulgurofícus triserialis* Whitf.	67, **67**
18.	*Cassidaria brevidentata* Ald.	67, **67**
19.	*Triton sublevis ?* var.	61, **61**
20.	*Cypræa smithi* Ald., x 0.80	69, **69**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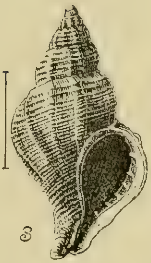
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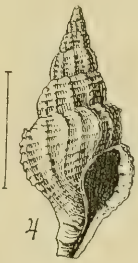
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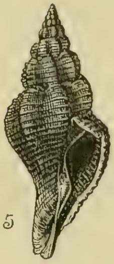
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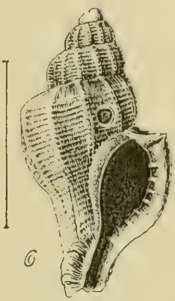
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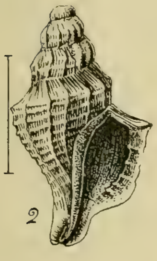
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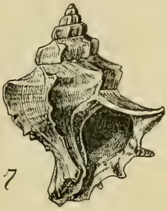
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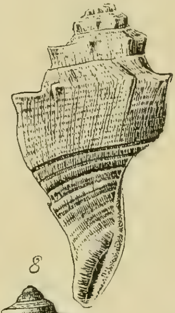
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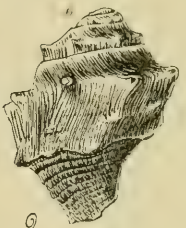
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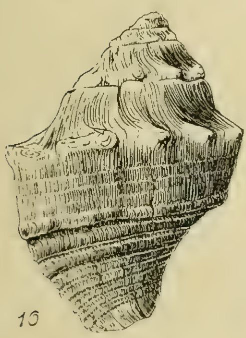
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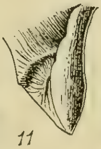
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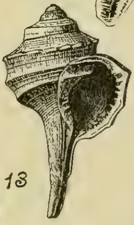
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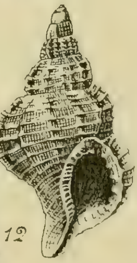
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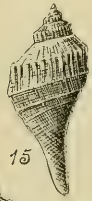
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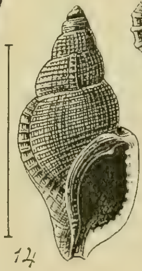
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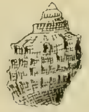
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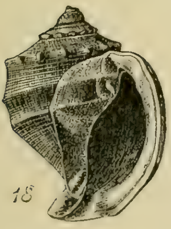
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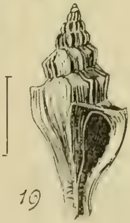
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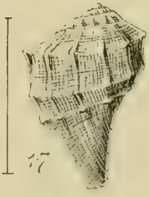
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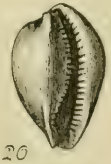
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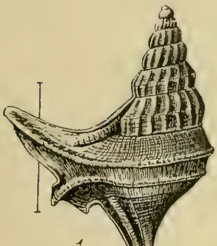
Plate 9.

EXPLANATION OF PLATE 9.

(9)

Fig.		Page.
1.	*Aporrhais gracilis* Ald	69, **69**
2a.	*Calyptraphorus trinodiferus* Con	70, **70**
3a, b.	*Melania trigemmata* Con	71, **71**
4.	*Potamides fulvarupis*, n. sp	71, **71**
5.	*Cerithium delicatulum* Ald. (after Ald.)	72, **72**
6.	*Cerithium ? tombigbeensis* Ald	72, **72**
7.	*Cerithiopsis fluviatilis* Ald. (after Ald.)	72, **72**
8.	*Cerithiopsis conica* Ald	73, **73**
9.	*Cerithiopsis terebropsis*, n. sp	73, **73**
10.	*Melania sylværupis*, n. sp	70, **70**



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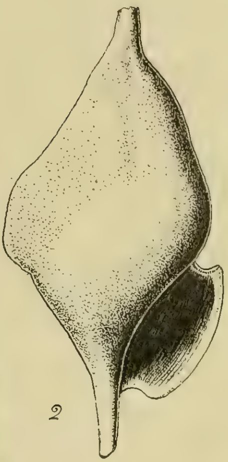

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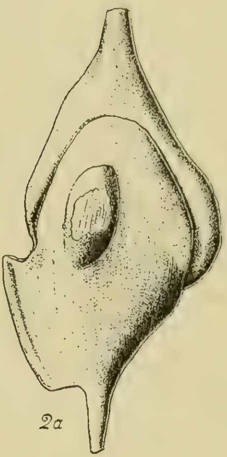

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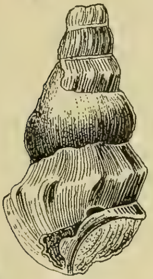

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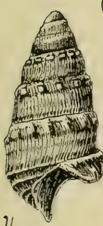

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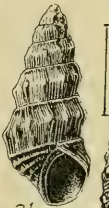

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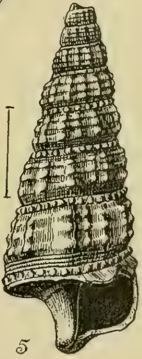

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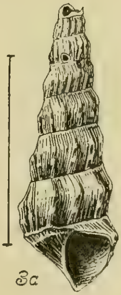

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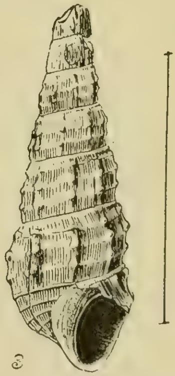

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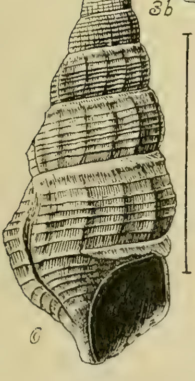

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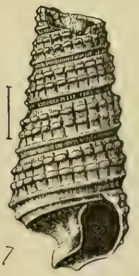

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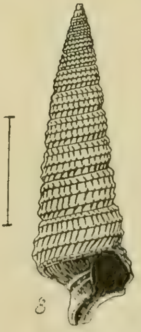

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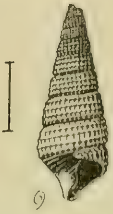

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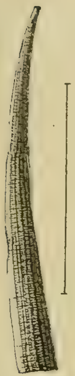
Plate 10.

EXPLANATION OF PLATE 10.

(10)

			Page.
Fig.	1.	*Serpulorbis sylværupis.*	73, **73**
	2.	*Turritella clevelandia*, var	74, **74**
	3.	*Turritella mortoni* (var. *post-mortoni*)	74, **74**
	4.	*Turritella mortoni* Con	74, **74**
	5.	*Turritella humerosa* Con., L. 8.5 cm	75, **75**
	6.	*Turritella humerosa* Con., var., L. 5 cm.,	75, **75**
	7.	*Turritella humerosa* Con., var., L. 5.7 cm	75, **76**
	8.	*Turritella præcincta* Con	76, **76**
	9.	*Mesalia pumila*, var. *alabamiensis* Whitf	76, **76**
	10.	*Melanopsis planoidea* Ald	77, **77**
	11.	*Melanopsis anita* Ald	77, **77**
	12.	*Tuba antiquata* Con. (Aldrich's figure), (young)	77, **77**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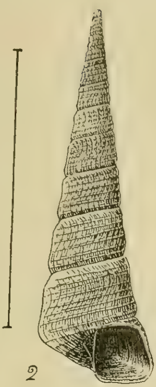
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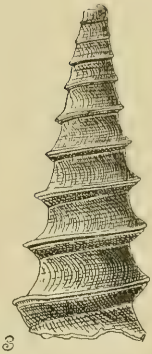
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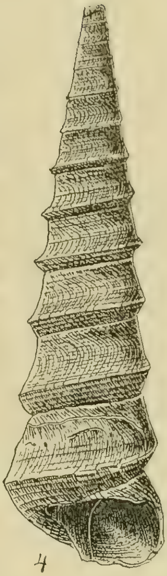
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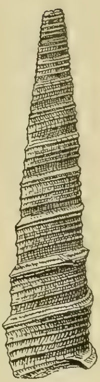
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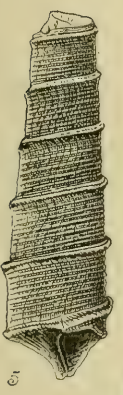
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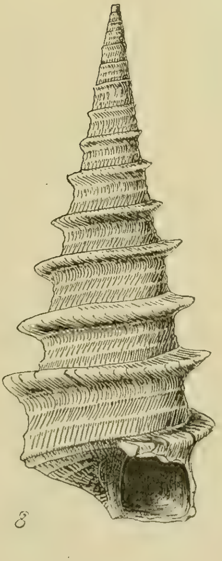
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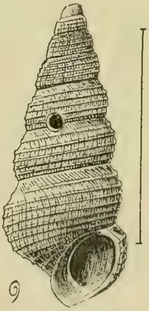
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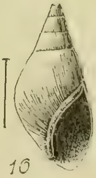
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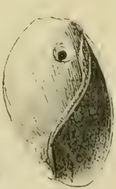
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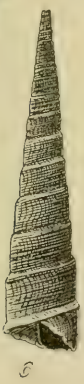
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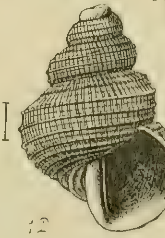
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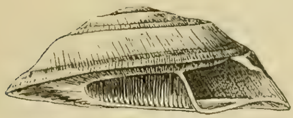
Plate II.

EXPLANATION OF PLATE 11.

(**11**)

		Page.
Fig. 1.	*Solarium sylværupis* Har. (slightly enlarged)...	78, **78**
2.	*Solarium cupola* Heilp. (slightly enlarged)......	78, **78**
3.	*Solarium huppertzi* var. x 1.60......................	79, **79**
4, a.	*Solarium greggi* Har., x 1.90........................	79, **79**
5.	*Solarium*, var. *delphinuloides* Heilp.................	80, **80**
6.	*Solarium leanum* Dall....................................	81, **81**
7.	*Solarium bellense*, n. sp................................	81, **81**
8.	*Solarium*, var. *intusum*, n. var........................	81, **81**
9.	*Discohelix verrilli* Ald., n. sp........................	82, **82**
10, a.	*Hipponyx sylværupis*, n. sp............................	83, **83**
11.	*Capulus expansus* Whitf. (young)..................	83, **83**
12.	*Capulus expansus* Whitf. (adult)....................	84, **84**
13.	*Calyptræa aperta* Sol. (adult broad variety)......	84, **84**
14.	*Calyptræa aperta* Sol. (base of fig. 16)............	84, **84**
15.	*Calyptræa aperta* Sol. (very young, showing involute apex; and spirals on expanded part of embryonic whorl)........................	84, **84**
16.	*Calyptræa aperta* Sol. (high, narrow form)......	84, **84**
17.	*Xenophora conchyliophora*...............................	85, **85**
18.	*Natica semilunata* Lea (common form, showing umbilical rib)..	86, **86**
19.	*Natica semilunata* Lea, var. (slightly enlarged, diseased, thickened form)........................	86, **86**
20	*Natica semilunata* Lea, var. (slightly enlarged, without umbilical rib)..........................	86, **86**
21.	*Natica* (*Sigaticus*) *clarkeana* Ald. (slightly enlarged)...	87, **87**
22.	*Natica eminula*, var.....................................	88, **88**
23.	*Natica magno-umbilicata* Lea.........................	89, **89**
24.	*Natica* (*Neverita*) *onusta* Whitf.....................	89, **89**
25.	*Natica* (*Neverita*) *onusta* Whitf. (very high form)..	89, **89**
26.	*Natica* (*Neverita*) *onusta* Whitf. (slightly enlarged, low, broad form)........................	89, **89**
27.	*Natica aperta* Whitf......................................	90, **90**
28.	*Natica* (*Lacunaria*) *erecta* Whitf.....................	91, **91**
29.	*Natica* (*Lacunaria*) *alabamiensis* Whitf. (slightly enlarged)..	91, **91**
30.	*Sigaretus declivus* Con.................................	93, **93**
31.	*Sigaretus bilix* Con......................................	93, **93**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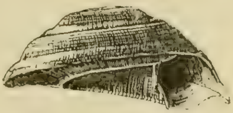
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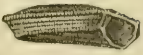
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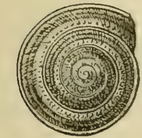
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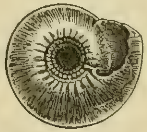
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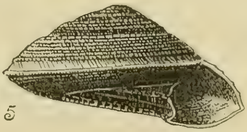
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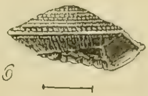
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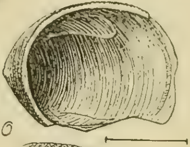
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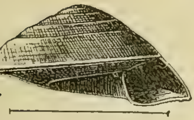
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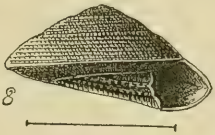
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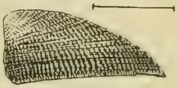
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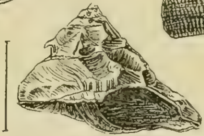
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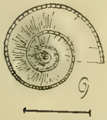
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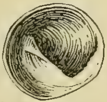
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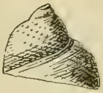
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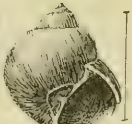
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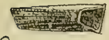
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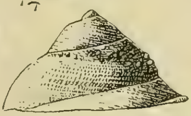
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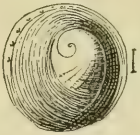
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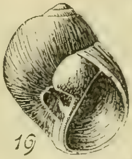
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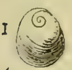
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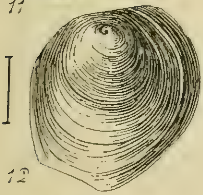
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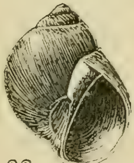
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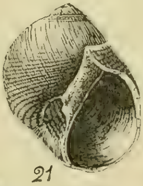
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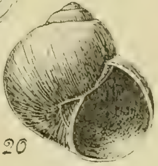
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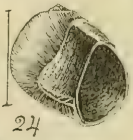
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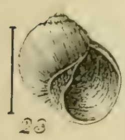
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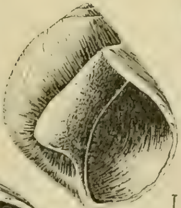
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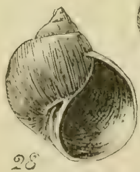
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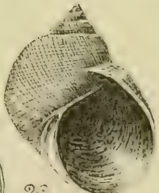
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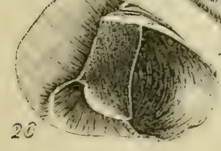
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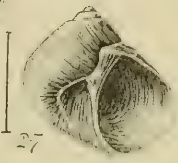
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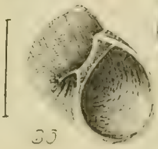
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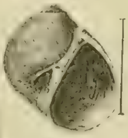
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Plate 12.

EXPLANATION OF PLATE 12.

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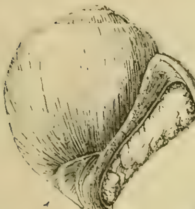
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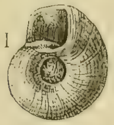
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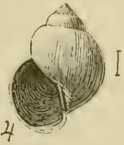
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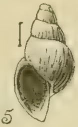
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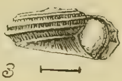
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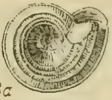
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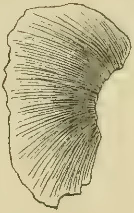
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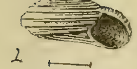
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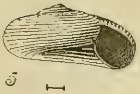
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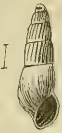
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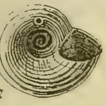
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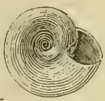
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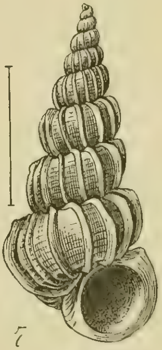
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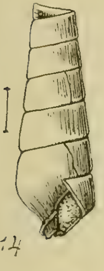
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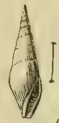
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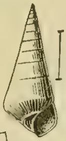
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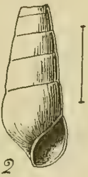
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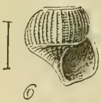
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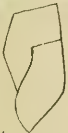
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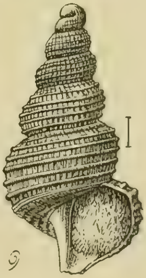
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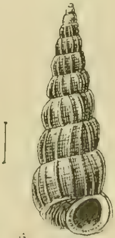
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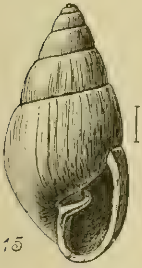
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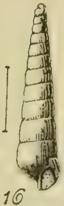
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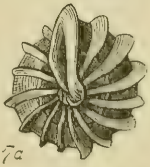
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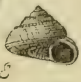
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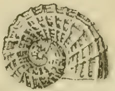
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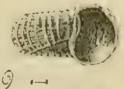
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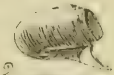
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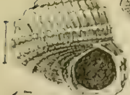
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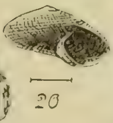
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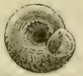
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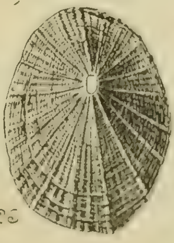
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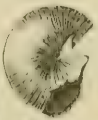
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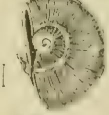
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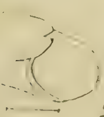
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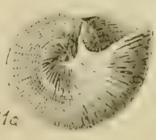
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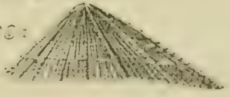
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No. 12

THE DEVONIAN AND LOWER CARBONIFEROUS FAUNAS OF SOUTHERN INDIANA AND CENTRAL KENTUCKY

BY

EDWARD M. KINDLE

June 5, 1899

Ithaca, N. Y.
U. S. A.

Smithsonian Institution
JAN 19 1910
National Museum

THE DEVONIAN AND LOWER CARBONIFEROUS FAUNAS OF SOUTHERN INDIANA AND CENTRAL KENTUCKY.*

by

EDWARD M. KINDLE.

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PART I.

INTRODUCTION.

The field work on which the present paper is based was done during the summer of '97 under the direction of Prof. H. S. Williams. A few of the sections studied then have been revisited during the last summer while collecting fossils for the United States Geological Survey.

The sections studied extend from the top of the "Knobstone" to the base of the Devonian. The area covered in the field includes a strip of country embracing the outcrops of these formations, which extends from the southern part of Bartholomew county, Indiana, southward to Lebanon Junction, Kentucky, and thence east to Crab Orchard, Kentucky, a distance of about 175 miles.

The facts which have been sought for in making and studying the collections may be referred to four classes of data: Those relating (1) to the geographical variation of the several faunas, (2) to the range and distribution of species, (3) to the relation of the several faunas to each other, and (4) the correlation of the faunas of this region with those of the type sections.

STRATIGRAPHY AND NOMENCLATURE.

The formations containing the faunas under discussion in this paper constitute six terranes whose limits are more or less sharply defined lithologically. Two of these formations are absent over most of the area studied in Kentucky, but all of these are present in southern Indiana.

RIVERSIDE SANDSTONE AND NEW PROVIDENCE SHALE.

The series of sandstone and shales known in the Indiana and Kentucky Reports as the "Knobstones" may be separated into two divisions which are lithologically decidedly unlike in most sections. The uppermost of these divisions consists usually of massive sandstones and sandy shales. Below the sandy shales and sandstones a blue clay shale is found resting either on the Black shale or the Rockford limestone. The name "New Providence shale" was used locally for this division of the "Knobstone" in 1873 by Mr. Borden. He used it to designate the lower Knob shales of Clark county, Indiana. In northern Indiana Mr. Hopkins has called the massive sandstone which is quarried extensively near Riverside P. O. the "Riverside sandstone." A study of a collection of fossils from the Riverside quarries indicates the identity of the Riverside sandstone of Hopkins and the upper division of the "Knobstone."

The "Knobstones" were first classed with a portion of the Lower Carboniferous limestones by Owen under the name of the "Siliceocalcareous series"*. In the revised reprint of Owen's Report published in 1859† the name "knobstones" first appears. It is used, according to the author, to designate "the fine grained free-stones with subordinate beds of grey shales" of the Knob regions. The name "Knobstone" has since been generally used in the Indiana Reports. It is a topographic term derived from the peculiar topographic forms developed in the Knob region of southern Indiana. The name therefore violates the modern rule of stratigraphic nomenclature, which requires the use of a definite geographical name for a geological terrane. The names introduced by Borden and Hopkins are used in the present paper instead of "Knobstones" for this reason, and also because they indicate the divisions of the "Knobstones," which are unlike faunally and lithologically.

The beds of this series reach their maximum development in Brown county, Indiana, where they attain a thickness of about six hundred feet and constitute the only surface rocks over a belt of country more than twenty miles wide. To the north and south the formations thin rapidly, and the Harrodsburg limestone usually extends to within a mile or less of the easternmost outcrop of the Riverside sandstone in southern Indiana and Kentucky. The Riverside sandstone dips to the west or southwest at the rate of from 26′ to 64′* to the mile. This formation usually presents along its eastern outcrop an escarpment from two to four hundred feet high, facing the comparatively level plain formed by the uniform weathering of the Black shale and the Devonian limestone. In northern Indiana Mr. Hopkins† has shown that the lowest member of the Coal measures rests unconformably on the Riverside sandstone.

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*Geol. Recon. of Ind., p. 14, 1837.

†Geol. Recon. of Ind., p. 21, 1859.

In southern Indiana and Kentucky the Harrodsburg limestone (Lower Carboniferous) is the formation which succeeds it.

ROCKFORD LIMESTONE.

The Rockford limestone is a thin bed of limestone from three to six feet thick which separates the Black shale from the New Providence shale. The formation is persistent throughout southern Indiana and is known to extend as far north as Columbus‡. It has not been seen south of the Ohio. Nearly all of the fossils described from it have been obtained near the village of Rockford, from which the formation has received its name. The earliest mention of this limestone seems to have been that of Owen and Norwood in 1847§.

NEW ALBANY BLACK SHALE.

The Black shale has been correlated with various formations. But the only local term which has been used is that given by Borden|| in 1873—the New Albany Black shale. It is a fine-

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*Newsome, Proc. Ind. Acad. Sci. 1897, p. 254.
*Bennett, " " " " " " 259.
*Kindle, " " " " 1895.
†20th. Ann. Rept. Ind. Dept. Geol. and Nat. Hist., pp. 196, 197.
‡Proc. Ind. Acad. Sci., 1897, p. 261.
§Researches among the Protozoic and Carboniferous Rocks of Central Kentucky, made during the summer of 1846; 12 pp.
||Ind. Geol. Rept., 1874, p. 88; 2d. Ann. Rept. 2d. Geol. Surv.

grained, arenaceous black shale, homogeneous throughout, and having a thickness of from 100 to 120 feet in southern Indiana. South of Louisville the New Albany shale becomes greatly reduced in thickness. At Brooks Station it is less than thirty feet thick.

South of the Ohio the New Albany shale has been found resting unconformably on the beds below. Near Brooks Station the shale was found resting unconformably on irregularly eroded Devonian limestone.

DEVONIAN LIMESTONES.

All of the Devonian beds at the Falls of the Ohio below the Black shale were at one time referred to the Upper Helderberg formation by Prof. Hall. He afterwards recognized the two-fold character of the faunas which they contain and correlated them with the Corniferous and Hamilton formations of New York. The Devonian near the Ohio in Indiana and Kentucky is readily separated into two divisions, which are easily distinguished from each other both by lithological and paleontological characters. In order to avoid further possible confusion in referring to the fossils of these divisions it will perhaps be best to use local names instead of the names of the New York formations hitherto used. For the upper portions of these beds, which are very arenaceous and silicious, the name "Sellersburg beds" is proposed, to include the beds from the New Albany shale down to the lowest beds worked at the cement quarries. They are extensively worked near Sellersburg for cement. These beds consist of a fine-grained calcareous sandstone from six to twenty feet thick and a thin bed of limestone, which when present lies immediately under the New Albany Black shale.

The limestone lying between the Sellersburg beds and the *Catenipora* beds of the Niagara are well exposed at the Falls of the Ohio between Jeffersonville and the mouth of Silver creek, and may be called the Jeffersonville limestone.

The Devonian formations below the New Albany shale are frequently entirely absent in the Kentucky sections, and where present they are usually represented by only a few feet of strata. The Sellersburg beds have not been seen south of Louisville. The attenuated character of the lower Devonian beds in Kentucky has been generally explained as due to thinning out*. Prof. N. S. Shaler did not recognize any stratigraphic break at the base of the New Albany shale† and regarded it as the equivalent of the New York Devonian formations down to the Oriskany‡, where the Cornifernus was wanting in the Kentucky section. The writer has found sections which show unconformity between the New Albany shale and the beds below in Kentucky. This interval of erosion which has been detected at the base of the Black shale explains the entire absence of the Devonian limestone at many localities and its extreme thinness where present.

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*Pal. N. Y., vol. 5, pt. 2, p. 140.
†Geol. Surv. of Ky., n. ser., vol. 3, p. 174.
‡ " " " " " " " " " 173.

PART II.

‡

SECTIONS.

SAND CREEK AND WHITE RIVER SECTIONS.

Sand creek is one of the eastern tributaries of the East fork of White river, and joins that stream sixty miles north of Louisville. It crosses the Devonian belt from east to west and along its valley occur some of the northernmost outcrops of the Devonian limestone to be met with in the state south of the Wabash valley.

Station 2C.—At Scipio the New Albany shale outcrops just southwest of the Episcopal church at the roadside and contains an abundance of *Styliola fissurella*.

A few hundred yards to the southwest of 2C the Devonian limestone outcrops along a ravine. A small amount of collecting from the limestone a few feet below the Black shale afforded the following species:

Chonetes yandellanus, *Dalmanites* sp., *Glyptodesma erectum*, *Spirifer acuminatus*, *Spirifer varicosus*, *Stropheodonta perplana*, *Stropheodonta demissa*, *Tentaculites bellulus*.

Station 2A.—West of Scipio one and one-half miles, good outcrops of the limestone occur at the side of the wagon road which afforded the following fossils:

Glyptodesma occidentale, *Orthothetes chemungensis arctostriatus*, *Platyceras carinatum*, *Polypora* sp., *Proetus* sp., *Proetus microgemma*, *Spirifer acuminatus*, *Stropheodonta demissa*, *Stropheodonta inequistriata*, *Stropheodanta perplana*, *Tentaculites* sp.

Station 1B.—At an old quarry on the south side of Sand creek three-fourths of a mile above Helt's mill about eight feet of limestone is exposed, containing an abundance of fossils. Those obtained were:

Onychodus sigmoides?, *Pleurodictyon problematicum*, *Polypora* sp?, *Proetus canaliculatus?*, *Spirifer acuminatus*, *Stropheodonta demissa*, *Stropheodonta perplana*, *Tentaculites bellulus.*

Spirifer acuminatus is the predominant species and is very abundant here.

Below the quarry a hard grey magnesian limestone, which is probably of Niagara age, is exposed. No fossils were found in it.

Station 1A.—At Helt's Mill the broken dam gives access to the Black Shale, which outcrops above it in the bed of the stream and rises a few inches above the water level. The shale forms the bed of the mill-race and has an outcrop of several square yards on the south side of the creek directly below the dam. On the opposite side of the stream, however, there is an exposure of hard dark blue to black limestone instead of the shale. The following fossils were collected from the Black shale:

Cardiopsis sp., *Chonetes lepida* (a), *Leiorhynchus limitaris* (a), *Tentaculites fissurella* (a).

Station 4A.—About three and one-half miles west of North Vernon, along the Seymour and North Vernon road, limestone is well exposed along the banks of a small stream. The fossils found here are:

Chonetes yandellanus? (r), *Pleurodictyon problematicum* (a), *Spirifer acuminatus* (c), *Spirifer varicosus* (r), *Streptorhynchus chemungensis* var. *arctostriatus*, *Stropheodonta demissa* (a), *Stropheodonta hemispherica* (c), *Stropheodonta perplana* (c), *Tentaculites scalariformis* (c).

About eight miles below the mouth of Sand creek at Rockford the Rockford limestone outcrops in the bed of the river, but no fossils were obtained at the time of my visit owing to the stage of the water. This is the type locality of the Kinderhook fauna and the following is a list of the species which have been described or reported from it.

Rockford fossils—

Cœlenterata: *Sphenopterium enorme* M. and W. (Winchell) (Meek and Worthen); *Zaphrentis ida* Win., (Winchell).

Echinodermata: *Synbathocrinus oweni* Hall, (Hall).

Brachiopoda: *Athyris biloba* Win., (*Spirigera biloba*) (Winchell); *Chonetes geniculata* White, (Winchell); *Chonetes illinoisensis* Worthen, (Schuchert); *Chonetes illinoisensis* Worthen, (Winchell); *Productus concentricus* Hall, (Winchell); *Reticularia cooperensis* Hall, (*Spirifer semiplicatus*) (Hall), (Meek and Worthen); *Rhipidomella occasus* Hall, (*Orthis occasus*) (Hall); *Rhynchonella missouriensis* Shum., (Meek and Worthen); *Rhynchonella obsolescens* Hall, (Hall); *Rhynchonella ? tetraptyx* Win., (Winchell).

Pelecypoda: *Anatina leda* Hall, (Hall); *Aviculopecten tenuicostus* Win., (Winchell); *Cardiomorpha radiata* M. and W., (Meek and Worthen); *Cypricardia ventricosa* Hall, (Hall); *Megambonia lyoni* Hall, (Hall); *Nucula hians* Hall (Hall).

Gastropoda: *Bellerophon cyrtolites* Hall, (Hall); *Bellerophon lineolatus* Hall, (Hall); *Euomphalus lens* Hall, (Hall); *Euomphalus spirorbis* Hall, (Hall); *Loxonema turritiforme* Hall, (Hall); *Murchisonia* (*Pleurotomaria ?*) *limitaris* Hall, (Hall); *Pleurotomaria ? mitigata* Hall, (Hall); *Pleurotomaria vadosa* Hall, (Hall); *Pugiunculus ?* (*Theca*) *aculeatus* Hall, (Hall).

Cephalopoda: *Goniatites ixion* Hall, (Hall); *Goniatites lyoni* Meek and Worthen, (Meek and Worthen); *Gyroceras gracile* Hall, (Hall); *Nautilus* (*Discus*) *digonus* M. and W., (Meek and Worthen); *Nautilus* (*Discus*) *trisulcatus* M. and W., (Meek and Worthen); *Nautilus rockfordensis* Win., (Winchell); *Nautilus* (*Tremodiscus*) *discoidalis ?* Win., (Winchell); *Orthoceras icarus* Beecher, (Beecher); *Orthoceras indianensis* Beecher, (Beecher); *Orthoceras marcellensis* (Vanuxem) (Jas. Hall).

Trilobitæ: *Phillipsia doris* (Hall) Win., (Hall) (Winchell; *Phillipsia rockfordensis* Win., (Winchell).

Pisces: *Otodus multicarinatus* Nor. and W., (Norwood and Worthen.)

The Black shale outcrops on the east bank of White river two miles above Rockford, exposing a thickness of ten or twelve feet. A half day's digging at this point failed to discover any fossils.

Station 5B.—Southwest of Brownstown is a range of "Knobs" known as Chestnut Ridge. The massive buff sandstone capping these hills was found to be full of fossils at a small quarry near the top of one of the knobs, one and one-half miles southeast of Brownstown, south of the Brownstown and Tampico road. The following species were obtained here from the Riverside sandstone:

Aulopora sp. r, *Aviculopecten* sp. r, *Camarotœchia sappho* c, *Conularia newberryi* r, Crinoid stems r, *Cypricardinia* sp. c, *Cryptonella eudora* r, *Derbya keokuk* a, *Dielasma?*, *Lingulodiscina newberryi* Hall r, *Leiorhynchus newberryi?* r, *Macrodon* sp. c, *Orthoceras* sp. r, *Pleurotomaria* sp., *Productus newberryi* c, *Platyceras* sp., *Reticularia pseudolineata* a, *Rhynchonella* sp. r, *Schizodus triangularis* r, *Spirifer keokuk* a, *Spiriferina depressa* c, *Spiriferina* sp., *Streblopteria* sp. c, *Syringothyris* sp. r.

The New Providence shale forms the lower portion of the hills here and the beds of the streams. No fossils were found in it save worm trails, which are everywhere abundant, and a single specimen of *Spirifer mortonanus*, which was broken out of the shelly sandstone in the bed of a small ravine about one mile northeast of station K5B.

THE MUSCATATUCK SECTION.

The outcrops included in this section extend from the eastern limit of the Devonian near Wirt station in Jefferson county to Ft. Ritner at the eastern edge of the Harrodsburg limestone in Lawrence county, a distance of about forty miles.

The easternmost stations of this section are those at Lancaster, on the west side of Big creek. The bed of the creek here is in the Upper Silurian rocks, while the upper part of the bluffs are of Devonian limestone, full of fossil corals and brachiopods. Just below Mr. George Ferris' house the coral beds are well exposed.

Station 10B.—On the west bank of the creek just above the bridge the following fossils were obtained:

Atrypa aspera r, *Atrypa reticularis* a, *Glyptodesma occidentale* r, *Onychodus sigmoides* c, *Orthis iowensis* a, *Phacops* *rana?* c, *Pleurodictyon problematicum* c, *Pterinea flabellum?* r, *Rhynchonella tethys* r, *Spirifer acuminatus* a, *Spirifer davissi*, *Spirifer fornaculus* r, *Spirifer varicosus* c, *Streptorhynchus* sp. r, *Stropheodonta concava* r, *Stropheodonta hemispherica* c, *Stropheodonta* sp., *Tentaculites scalariformis* r.

Station 10B'.—The Devonian limestone here is full of flint concretions of all sizes, which contain beautifully preserved fossils. The following were obtained from weathered masses of flint on Mr. George Ferris' land a short distance north of station 10B:

Actinopteria boydi r, *Bucania devonica* r, *Clinopistha subnasuta* r, Crinoid stems r, *Cyclonema cancellatum* r, *Glyptodesma erectum* r, *Glyptodesma occidentale* a, *Orthis propinqua* r, *Platyceras erectum* r, *Platyostoma lineatum* r, *Pleurotomaria sulcomarginata* r, *Rhynchonella tethys* r, *Spirifer acuminatus* a, *Spirifer euruetelnes* a, *Spirifer varicosus* r, *Streptorhynchus arcostriata* r, *Stropheodonta concava* c, *Stropheodonta demissa* a, *Stropheodonta hemispherica* c, *Stropheodonta perplana* c.

The fossils in the lower part of the bluff are chiefly corals.

At the ford one and one-half miles east of Paris Crossing, Upper Silurian rocks form the bed of the stream, while the Jeffersonville limestone constitutes the upper twenty or thirty feet of the bluffs.

Station 9C.—The following species were obtained from the top of the bluff near the spring:

Atrypa reticularis c, *Chonetes arcuatus* a, *Chonetes pusillus* c, *Glyptodesma occidentale*, *Orthis iowensis* c, *Onychodus sigmoides* c, *Rhynchonella tethys* c, *Spirifer acuminatus* a, *Spirifer iowensis* c, *Stropheodonta demissa* c, *Tentaculites bellulus* c.

Spirifer acuminatus is extremely abundant and the predominant form at this station. *Chonetes arcuatus* is very abundant and stands next to *Spirifer acuminatus* in the number of individuals.

Station 8A.—About one and one-half miles west of Paris Crossing the Sellersburg limestone and a few feet of Black shale above it are exposed in a small quarry on the south side of the road. The following fossils, representing a Hamilton fauna, were obtained from the limestone:

Atrypa reticularis r, *Chonetes arcuatus* a, *Cladopora* a, Crinoid stems a, *Cyrtina hamiltonensis?* r, *Onychodus sigmoides* r, *Product-*

ella subaculeata var. *cataracta* c, *Schizophoria striatula* c, *Spirifer byrnesi* c, *Spirifer granuliferus* r, *Spirifer grieri ?*, *Spirifer iowensis* (*Spirifer pennatus*) c, *Stropheodonta demissa*, *Stropheodonta hemispherica*, *Stropheodonta perplana* c.

Station 8B.—The following species were obtained from the three and one-half feet of Black shale outcropping above the limestone:

Chonetes lepidus a, *Lingula spatulata* a, *Tentaculites fissurella* a.

Station 7A.—At the wagon bridge over the Muscatatuck one mile below Crothersville the New Albany shale outcrops in the bed of the stream, and *Lingula spatulata* was found here abundantly.

Station 7B.—Just below the bridge the Rockford limestone is well exposed above the shale. It has here a thickness of five feet, and afforded the following fossils:

Ambocœlia gregaria a, *Athyris* nov. sp., *Chonetes geniculatus* White ? a, *Chonetes illinoisensis* Win. c, *Chonetes logani* N. and P ? r, Crinoid stems c, *Goniatites lyoni* M. and W. r, *Goniatites oweni* Hall c, *Leiorhynchus ?*, *Leperditia* sp. r, *Nucula* nov. sp., *Orthoceras icarus* Hall r, *Orthoceras indianense* Hall c, *Palæoneilo* sp. r, *Phillipsia doris* (H.) Win. c, *Platyceras* sp. r, *Pleurotomaria* sp. r, *Productella concentrica* Hall ?, *Rhipidomella ocassus* Hall ?, *Rhombopora ?*, *Rhynchonella obsolescens* H.? r, *Spirifer* sp., *Spirifer marionensis* Shum.? c, *Spiriferina solidirostris* a, *Zaphrentis* sp. r.

Five or six miles west of the last station the flat country, which is underlaid by the Black shale and Rockford limestone, gives way to the belt of knobs, which is here about twenty miles wide.

Station 22A.—At Low Gap ridge, near Lesterville, Washington county, fossils were found abundantly in the Riverside sandstone. At the "gap," which is about one mile north of the school house, the following fossils were obtained:

Camarotœchia sappho c, *Chonetes logani* a, *Derbya keokuk* c, *Myalina keokuk* c, *Orthothetes crenistria ?* r, *Pleurodictyon problematicum* r. *Productus newberryi* a, *Productus semireticulatus* c, *Spirifer keokuk* r, *Syringothyris texta* a, *Tentaculites* sp. r.

Station 22B.—A quarter of a mile S. E. of the school house on Low Gap ridge some of the strata exposed at the roadside are very fossiliferous and furnished the following species:

Allorisma sp. r, *Aviculopecten* sp. c, *Camarotœchia sappho* a, *Cypricardinia* sp., *Cryptonella eudora?* r. *Derbya keokuk* a, *Discina* sp. c, *Grammysia* sp. r, *Leiropecten* sp. c, *Mytilarca?* r, *Platyceras* sp. c, *Pleurotomaria* sp. a, *Proetus auriculatus* r, *Reticularia pseudolineata* a, *Spirifer?* sp., *Spirifer keokuk* a, *Spiriferina* sp., *Spiriferina depressa* c, *Streblopteria gracilis* c, *Streblopteria media* c.

The western limit of the Riverside sandstone along this section is found about one and one-half miles east of Ft. Bitner, Lawrence county.

PIXLEY KNOB AND LEXINGTON SECTION.

This section crosses the Devonian and "Knob" region in a northeasterly and southwesterly direction, extending from Kent P. O. through Lexington and the Guinea "knobs" and ending at Pixley's "knob," about five miles west of Henryville. The stations are from eight to twenty miles south of those of the Muscatatuck section.

Station 11A.—On the west side of the creek near Kent P. O. the Jeffersonville limestone is well exposed in the banks of the stream. Just north of the old saw-mill the coral beds are well exposed and contain few other fossils than corals.

Aulopora serpens?, *Cladopora?*, *Diphyphyllum* sp. a, *Zaphrentis* sp. c, *Zaphrentis compressa* r.

Station 11B.—On the south side of the road opposite the saw-mill, at a slightly higher level than the coral beds of the last station, the following fossils were obtained:

Atrypa reticularis a, *Chonetes* sp. r, *Spirifer euruteines* r, *Spirifer iowensis* c, *Terebratula lincklæni* H. r.

Station 11C.—The slope of the hill northwest of the saw-mill is strewn with numerous masses of flint weathered from the limestone, which contains beautifully preserved fossils. The following were obtained from these flint nodules:

Bellerophon sp., *Bucania devonica* r, *Callonema bellatulum* r, *Crania doria* r, *Cyrtina hamiltonensis* c, *Glyptodesma occidentale* c, *Loxonema hydraulicum; Orthis striatula* a, *Orthis vanuxemi* a, *Palæoneilo* sp., *Platyceras buculentum* r, *Platyceras erectum* c, *Platyostoma lineatum* var. *callosum* r, *Productella subaculeata* var. *cataracta* r, *Proetus crassimarginatus*, *Rhynchonella tethys* r, *Spirifer acuminatus* c, *Spirifer arctisegmentus* r, *Spirifer segmentus* r, *Spirifer varicosus* r, *Streptorhynchus arctostriatus* r, *Stropheodonta demissa* a, *Stropheodonta hemispherica* c, *Stropheodonta perplana* a.

Lexington.—In the vicinity of Lexington the Sellersburg beds and the New Albany shale are exposed and afford excellent opportunities for collecting. The upper eight or ten feet of the beds just below the shale are very silicious, almost a sandstone. On exposed slopes the fossils from these beds weather out in an excellent state of preservation. Directly below these silicious beds is a blue limestone, replete with *Orthis vanuxemi* and *Orthis striatula.* I obtained the following species from these beds at a small quarry a quarter of a mile north of the railroad station.

Station 12A.—

Orthis striatula a, *Orthis vanuxemi* a, *Spirifer byrnesi* c, *Spirifer euruteines* c, *Stropheodonta hemispherica* c.

Station 12A′.—Just below these *Orthis* beds is the Jeffersonville limestone, in which the more common species at this quarry are the following:

Platyceras erectum r, *Spirifer acuminatus* c, *Stictopora* sp., *Stropheodonta demissa* c, *Stropheodonta hemispherica* a.

Station 12B′.—From the Sellersburg beds just below the New Albany shale, a few rods northeast of the railroad station at Lexington, the following species were secured:

Chonetes sp., *Chonetes yandellanus* a, *Cystiphyllum* sp.?, *Phacops rana* r, *Proetus canaliculatus?* r, *Roemerella grandis* r, *Spirifer oweni* c, *Stropheodonta demissa* c, *Stictopora* sp. c, *Tropidoleptus carinatus* a.

Station 12B″.—From the Sellersburg beds one-half mile south of the railroad station, just east of the track, the following species were collected:

Athyris vittatus r, *Atrypa reticularis* c, *Aulopora* sp. r, *Camarotœchia tethys?* r, *Chætetes arbusculus?* r, *Coleolus aciculum*, *Hyolithes* sp., *Macrocheilus carinatus* r, *Macrochilina* n. sp. r, *Microcyclas* sp. c, *Modiomorpha concentrica* r, *Paracyclas ellipticus* r, *Spirifer byrnesi* a, *Spirifer euruteines* r, *Spirifer segmentus?* r, *Spirifer varicosus* a.

Station 12B.—One mile east of Lexington the following species were found in the same beds as the last station, on Dr. Davis' land south of the road:

Atrypa reticularis c, *Discina grandis* r, *Spirifer granulosus* a, *Stictopora* sp. c.

Station 12C.—In the bed of a small ravine a few hundred yards above Dr. Davis' house the New Albany shale is encountered, and the lower layers of it contain in great abundance the following species:

Chonetes lepidus c, *Leiorhynchus quadricostatus* a, *Tentaculites fissurella* a, *Tentaculites gracilistriatus* r.

Powers' collection.—The following is a list of the species in a collection made by Mr. John Powers at Lexington and kindly loaned to the writer for study:

Athyris vittata, *Bellerophon leda*, *Callonema imitator*, *Camarotœchia carolina*, *Camarotœchia congregata*, *Cyrtoceras jasoni*, *Favosites* sp., *Glossites* sp., *Gomphoceras minum*, *Loxonema hydraulicum*, *Machæracanthus major*, *Modiomorpha concentrica*, *Orthoceras* sp., *Paracyclas elliptica*, *Platyceras erectum*, *Proetus canaliculatus*, *Spirifer byrnesi*, *Spirifer varicosus*.

Station 13A.—Southwest of Lexington five and one-half miles, in the Guinea "knobs" the Rockford limestone is well exposed at John Koerner's. The following fauna was obtained here:

Ambocœlia gregaria (Win.) Schu. c, *Athyris ohioensis* Win.?, *Bellerophon* sp., *Cryptonella ? inconstans* r, *Phillipsia doris* (H.) Win. a, *Productella* sp.? r, *Spirifer marionensis* Shum. c, *Spiriferina solidirostris*.

Station 24A.—The New Providence shale is well exposed at the side of the wagon road which ascends Pixley knob. This is one of the very few localities where this shale was found to be fossiliferous in southern Indiana. The species which were found here are the following:

Athyris lamellosa c, *Athyris ohioensis ?* r, *Atrypa* sp. r, *Bellerophon crytolites ?* r, *Camaortœchia* sp., *Chonetes illinoisensis* c, *Chonetes logani* c, *Crenipecten fœrstii ?* r, Crinoid stems a, *Cyclonema* sp., *Cyrtina ?* r, *Forbesocrinus* sp. r, *Macrodon* sp., *Nucula* sp., *Orthothetes* sp., *Palæoneilo bedfordensis* c, *Platyceras* sp., *Pleurotomaria* sp., *Polyphemopsis* sp.? r, *Productus arcuatus ?* a, *Productus gracilis* r, *Productus pyxidatus* c, *Productus semireticulatus* c, *Productus shumardanus?* c, *Rhynchonella* sp. r, *Scaphiocrinus* sp. r, *Spirifer keokuk* a, *Spirifer suborbicularis* c, *Spiriferina* sp., *Syringothyris* sp. r, *Zaphrentis* sp.

Station 23A.—North of Bartel P. O., Washington county, the shelly ferruginous sandstone of the Riverside formation exposed at the roadside contains an abundant fauna, from which the following species were collected:

Aulopora sp. c, *Bellerophon* sp., *Bellerophon crassus* r, *Bellerophon galericulatus* Win?, *Camarophoria* sp., *Camarotœchia sappho* a, *Chonetes illinoisensis* a, *Conocardium pulchellum* r, *Cypricardinia Edmonia* sp., *Goniatites greeni* r, *Macrodon* sp., *Naticopsis* sp., *Orthoceras* sp. r, *Orthothetes crenistria* c, *Phæthonides* sp. nov.? r, *Productus semireticulatus* c, *Productus newberryi*, *Proetus auriculatus* (H.) c, *Ptychopteria sexplicata*, *Spirifer keokuk*, *Spirifer pseudolineata* c, *Spirifer tenuispinatus* r, *Spiriferina depressa* (H.)? a, *Strophostylus* sp., *Streptorhynchus* sp., r, *Zaphrentis* sp. r.

BORDEN SECTIONS.

The Riverside sandstone is well exposed near Borden and fossils were found in it abundantly at two or three localities.

Station 14A.—West of Borden about one and one-half miles the sandstone outcropping in the wagon road one-half a mile north of the railroad contains the following species:

Camarotœchia sappo c, *Chonetes* nov. sp., Crinoid stems c, *Cypricardella* sp. r, *Derbya keokuk* a, *Hyolithes* sp. r, *Macrodon* sp. a, *Myalina keokuk* c, *Orthoceras* sp., *Pleurotomaria* sp., *Productus newberryi* c, *Productus semireticulatus* c, *Pterinopecten* sp. r, *Schizodus chemungensis* r, *Sphenotus?* sp., *Sphenotus valvulus?* r, *Syringothyris texta* a.

Station 14B.—On the west side of Saw-mill branch a half mile south of Borden the Riverside sandstone is fossiliferous toward the top of the hill where exposed at the roadside. The following fauna was found here:

Camarotœchia sappho a, *Derbya keokuk* a, *Leiopteria* sp., *Orthothetis crenistria?* r, *Pentremites* sp. r, *Productus gracilis* r, *Spathella typica* r, *Syringothyris textus* c.

Spirophyton crassum was found in the Riverside sandstone along Saw-mill branch south of Borden.

CEMENT QUARRIES.

The fine-grained calcareous sandstone lying just below the Black shale is quarried for cement at a number of localities in Clark county. These silicious beds are usually from ten to fifteen feet in thickness. The name Sellersburg beds has been given them in this paper from the name of the town near which they are extensively quarried. At the quarry of Speed & Co., near Sellersburg, the rock is a bluish grey fine grained sandstone four feet thick.

Station 19A.—Speed & Co.'s cement quarry, one and one-half miles north of Sellersburg. The species obtained here are:

Atrypa reticularis c, *Chonetes yandellanus* a, *Orthis* sp., *Rynchonella tethys* r, *Spirifer granuliferus* r, *Spirifer segmentus* c, *Spirifer varicosus* r, *Stropheodonta demissa* r.

Station 19B.—Speed & Co.'s cement quarry, one and one-half miles north of Sellersburg.

The following species were collected from the weathered clay near the quarry and represent the same fauna as 19A.

Athyra vittata a, *Atrypa reticularis* a, *Chonetes yandellanus* a, Crinoid stems c, *Loxonema hydraulicum* r, *Proetus ?* r, *Spirifer byrnesi* r, *Spirifer euruteines* r, *Spirifer granulosus* a, *Spirifer varicosus* r, *Stropheodonta demissa* c.

Station 19A'.—Limestone quarry one-half mile east of Sellersburg.

The rocks exposed at the quarry belong to the Jeffersonville limestone and afforded the following species:

Atrypa reticularis r, *Chonetes mucronatus* r, *Favosites emmonsii* r, *Michelinia favositoidea* r, *Orthis iowensis* c, *Spirifer acuminatus* c, *Spirifer gregarius* a, *Stropheodonta demissa* c, *Stropheodonta hemispherica* c, *Stropheodonta perplana* r, *Strophomena rhomboidalis* a.

The following section is exposed at the cement quarry just west of Watson:

Surface clay	3′	
Black shale		18″
Argillaceous sandstone with chert	5′	18″
Fine grained sandstone ("Cement rock")	9′	

Station 18A.—Cement quarry at Watson.

The following species were obtained from the fine grained sandstone:

Athyris vittata a, *Atrypa reticularis* c, *Chonetes yandellanus* a, *Fenestella* sp. c, *Lichenalia* sp. c, *Michelinia favositoidea* r, *Spirifer byrnesi* c, *Spirifer granuliferus* a, *Spirifer iowensis* c, *Spirifer varicosus* a, *Stropheodonta demissa* a, *Stropheodonta hemispherica* c.

Station 18B.—Cement quarry at Watson.

The fossils in this list are from the residual clay at the quarry and represent the same fauna as at 18A.

Athyris spiriferoides?, *Athyris vittata*, *Atrypa reticularis* Hall a, *Camarotœchia congregata* H., *Chonetes yandellanus?* a, *Meristella haskinsi* Hall, *Meristella unisulcata*, *Orthis livia* Billings, *Paracyclas elliptica* Hall, *Phacops rana* Hall, *Schizophoria striatula* Schlot., *Spirifer davisii* Nettleroth, *Spirifer fornaculus* Hall, *Spirifer granulosus* Hall, *Spirifer oweni*, *Spirifer segmentus* Hall, *Spirifer varicosus* Hall, *Zaphrentis* sp.

CHARLESTOWN.

Fourteen Mile creek cuts through the Jeffersonville limestone and exposes the Niagara sandstone and shale along the sides of its valley a short distance east of Charlestown. The abundance of well-preserved Devonian fossils in the residual limestone clay about Charlestown has long made it a favorite locality for collectors. The following Devonian species from Charlestown are in the Indiana State Museum:

Athyris vittata c, *Atrypa reticularis* c, *Loxonema hydraulicum* c, *Microdiscus* sp. c, *Nucula niotica* c, *Spirifer granuliferus* r, *Spirifer gregarius* r, *Spirifer segmentus* r, *Stropheodonta hemispherica* r.

The specimens from stations 20A and 20B are from clays which have been produced by the weathering of the Jeffersonville limestone and the Sellersburg beds, and hence are representative of both formations.

Station 20C.—Three and one-half miles east of Charlestown.

The following fauna was collected at the roadside:

Atrypa reticularis r, *Bucania devonica* c, *Chonetes mucronatus* c, *Chonetes yandellanus* c, *Conocardium trigonale* r, *Discina grandis* r, *Glyptodesma occidentale*, *Orthis iowensis* c, *Polypora* sp., *Proetus* sp. r, *Spirifer acuminatus* c, *Spirifer byrnesi* r, *Spirifer gregarius* a, *Stropheodonta demissa* c, *Stropheodonta hemispherica* c, *Stropheodonta perplana c.*

The following species from Charlestown, Indiana, are in the State Museum:

Atrypa aspera, *Camarotœchia tethys*, *Chonetes yandellanus*, *Cyrtina hamiltonensis* Hall, *Meristella nasuta*, *Orbiculoidea ampla* Hall, *Orbiculoidea seneca* Hall, *Schizophoria propinqua ?*, *Spirifer consobrinus* d'Orbig, *Spirifer euruteines*, *Spirifer granulosus* Hall, *Spirifer pennatus* Atwater, *Stropheodonta demissa* Hall, *Stropheodonta hemispherica* H.

Station 20A.—East of Charlestown, near Fourteen creek.

The following species were picked up from the residual clay at the roadside:

Bucania devonica, *Microdiscus* sp. c, *Spirifer acuminatus* a, *Spirifer euruteines* r, *Spirifer gregarius* a, *Stropheodonta demissa* r.

Station 20B.—Three miles east of Charlestown in an old field.

OHIO FALLS AND EDWARDSVILLE SECTION.

The Niagara limestones which are so well exposed just east of Louisville are brought below the bed of the Ohio at the Falls by the westerly dip of the beds, which is probably 25′ or 30′ to the mile.

The Devonian beds are well exposed along the north bank of the Ohio almost to the mouth of Silver creek, where their outcrops are succeeded by those of the New Albany shale. At New

Albany the Rockford limestone is about three feet in thickness in the bed of the stream at the northwest side of the town. Just west of New Albany the New Providence shale is well exposed along the track of the Air Line railroad. The massive sandstone of the Riverside formation which follows this shale is well exposed at the tunnel near Edwardsville, four miles west of New Albany.

The following is a connected section of the rocks exposed between the Falls of the Ohio and Edwardsville:

GENERALIZED SECTION FROM THE FALLS OF THE OHIO TO EDWARDSVILLE.

7.	Harrodsburg limestone	
6.	Riverside sandstone (massive to shelly sandstone and sandy shales)	200′
5.	New Providence shale (blue arenaceous shales)	125′
4.	Rockford limestone	3′
3.	New Albany Black shale	104′
2.	Sellersburg beds	15′
1.	Jeffersonville limestone	20′

The entire thickness of the Jeffersonville limestone is not shown in any single section, but its thickness probably does not exceed twenty feet in the vicinity of the Falls of the Ohio.

Station 17A′.—Falls of the Ohio.

The following list of species is from the Jeffersonville limestone on the north bank of the river about a half mile below the J. M. & I. bridge:

Atrypa aspera r, *Atrypa reticularis* a, *Blothorphyllum decorticatum* c, *Chonetes* sp. *r*, *Conocardium trigonale ?* r, *Cyrtina hamilton-*

ensis r, *Discina* sp., *Diphyphyllum* sp., *Favosites hemisphericus* c, *Michelinia cylindrica* c, *Orthis livia* r, *Pentamerus nucleus ?* r, *Platyceras dumosum* r, *Platystoma lineatum* r, *Productella subaculeata* var. *cataracta* r, *Proetus canaliculatus* r, *Spirifer arctisegmentus* r, *Spirifer byrnesi* r, *Spirifer euruteines* r, *Spirifer gregarius* a, *Stropheodonta demissa* c, *Stropheodonta hemispherica* c, *Stropheodonta perplana* r, *Thecia minor* c, *Trochonema rectilatera* r, *Zaphrentis gigantea*, *Zaphrentis ungula* c.

Station 17B.—Near the government jetty on the Indiana side of the Falls.

The following species were obtained from about 3′ of the lowest beds exposed at low water:

Blothrophyllum sp. c, *Conocardium cuneus* a, *Favosites hemisphericus* c, *Holopea* sp. r, *Modiomorpha mytiloides* r, *Pentamarella arata* r, *Pleurotomaria* sp. r, *Proetus crassimarginatus* c, *Proetus microgemma* r, *Spirifer gregarius* r, *Spirifer varicosus* r, *Stropheodonta demissa*, *Stropheodonta perplana* r, *Terebratula lincklæni* c, *Zaphrentis giganteus* a.

Station 17B′.—Immediately above 17B the following species were obtained from about two feet of hard grey limestone:

Actinopteria boydi r, *Atrypa reticularis* c, *Callonema bellatulum* c, *Callonema imitator ?* c, *Chonetes mucronatus* c, *Conocardium cuneus* a, *Cyathophyllum rugosum* c, *Cyrtina hamiltonensis* r, *Dalmanites anchiops* var. *sorbrinus* r, *Dalmanites selenurus* r, *Glyptodesma occidentale* r, *Modiomorpha affinis* a, *Modiomorpha mytiloides* a, *Orthis iowensis ?* t, *Proetus crassimarginatus* c, *Ptychodesma* n. sp. r, *Stropheodonta arctostriatus* r, *Stropheodonta demissa* c, *Stropheodonta perplana* r, *Turbo shumardi* c, *Zaphrentis giganteus* c.

Station 17B″.—About six feet above B′ the limestone beds afforded the following species:

Atrypa reticularis c, *Chonetes mucronatus* c, *Proetus crassimarginatus ?* c, *Spirifer acuminatus* c, *Stropheodonta demissa* c, *Stropheodonta hemispherica* c.

Station 17A.—Near the south end of the J. M. & I. railroad bridge the fine grained calcareous sandstones lying just below the Black shale are quarried for cement. Three or four feet of rather pure limestone separates these sandy beds from the Black shale above. The "cement beds" here afforded the following species:

Atrypa reticularis a, *Chonetes yandellanus* a, *Leiorhynchus quadricostatum* c, *Proetus* sp., *Spirifer oweni* a, *Spirifer segmentus* c, *Spirifer subattenuatus* r, *Stropheodonta demissa* r.

No fossils were found in the Rockford limestone at New Albany.

Station 16A.—In the massive sandstone of the Riverside formation the following fauna was obtained at the east end of the Edwardsville tunnel on the Air Line railroad:

Aviculopecten sp. r, *Conularia micronema* r, *Derbya keokuk* a, *Macrodon ?* r, *Productus burlingtonensis* c, *Spirifer keokuk* a, *Syringothyris texta* c.

Bear Grass Creek Quarries, near Louisville.

Just east of Louisville the Niagara limestone is extensively quarried along the banks of Bear Grass creek. The tops of the hills in the vicinity of the quarries are usually capped with from ten to fifteen feet of the Jeffersonville limestone. The following section is exposed at the quarry south of the Institute for the Blind:

b.	White to light grey limestone	10 ft.
a.	Light bluish grey arenaceous limestone	35 ft.

The beds of "a" of this section contain characteristic Niagara fossils.

In the upper ten feet Devonian fossils are abundant. *Spirifer gregarius* occurs in great profusion and with a few species of corals furnishes the greater part of the fossils in some of the strata.

The fossils identified from these beds are as follows:

Station 15A.—Bear Grass quarries.

Atrypa reticularis a, *Aviculopecten princeps*, *Chonetes mucronatus* r, *Conocardium trigonale* r, Crinoid stems c, *Orthis iowensis* c, *Pentamerella arata* r, *Phacops cristata* var. *pipa*, *Platyceras carinatum* r, *Platyceras dumosum* r, *Platyceras echinatum* r, *Pleurodic-*

tyon problematicum r, *Polypora* sp. c, *Proetus crassimarginatus* c, *Spirifer* sp. r, *Spirifer acuminatus* r, *Spirifer byrnesi* r, *Spirifer gregarius* a, *Spirifer iowensis*, *Spirifer raricostus?* r, *Spirifer varicosus* r, *Streptorhynchus arctostriatus* r, *Stropheodonta demissa* c, *Stropheodonta hemispherica* r, *Stropheodonta perplana r*, *Terebratula lincklæni* r, *Zaphrentis* sp. c.

BROOKS SECTION.

A generalized section of the rocks in the vicinity of Brooks station, which is about fifteen miles south of Louisville, is as follows:

Massive sandstone	40-50 ft.
Sandy shale and sandstone	50-75 ft.
Blue clay shale	50-65 ft.
Black to chocolate colored shale	15-30 ft.
Devonian limestone	2 - 6 ft.
Niagara limestone and sandstone	15-20 ft.

The Black shale was found to rest unconformably on the Devonian limestone in the vicinity of Brooks. In the bed of Brooks run, between the railroad and the wagon road, the lower strata of the Black shale lie in shallow, irregularly eroded pockets in the limestone. In some of these a thin layer of reddish clay was observed between the limestone and the undisturbed Black shale. The unconformity observed here is shown in the accompanying figure (Fig. 1).

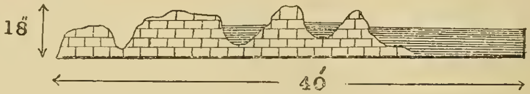

FIG. 1.—Section on Brooks Run, Bullitt County, Kentucky.

These Sellersburg beds are entirely wanting here.

The Devonian limestone of the above section probably does not exceed two feet in thickness. It afforded the following fossils:

Station 25A.—Brooks Run.

Actinopteria sp., *Atrypa reticularis* c, *Camarotœchia* sp., *Lichenalia* sp., *Orthis vanuxemi* r, *Pentamerella arata* r, *Phacops rana*, *Platyceras* sp., *Platyostoma lineatum* c, *Productella spinulicosta* r, *Proetus crassimarginatus* c, *Rhipidomella livia* r, *Spirifer divaricatus* r, *Spirifer fimbriatus* r, *Spirifer fornaculus* r, *Spirifer varicosus* r, *Stropheodonta demissa* r, *Stropheodonta perplana*.

The unconformity of the Black shale and the underlying limestones is well shown in a section exposed in the railroad cut a quarter of a mile south of Huber station. The shale on one side of the section here is separated from the limestone by about four inches of red clay.

The accompanying figure (Fig. 2) illustrates the relations observed between the shale and the limestone at this point.

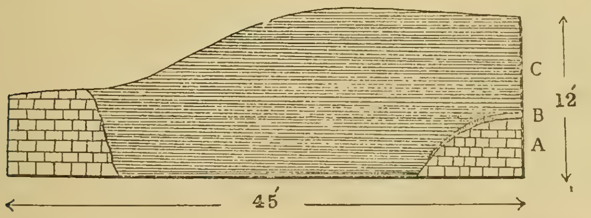

FIG. 2.—Section showing the unconformity of the Black shale and the Devonian limestone.

A. Devonian limestone.
B. Red clay.
C. Black shale.

The limestone just under the black shale in this section afforded the following species:

Station 26B.—Huber, Ky.

Ambocœlia umbonata a, *Camarotœchia tethys* c, *Orthis* sp., *Platyceras* sp., *Spirifer davisi?* r, *Spirifer fimbriatus* r, *Spirifer segmentus* r, *Spirifer varicosus* r, *Tropidoleptus carinatus* r.

The New Albany Black shale does not everywhere have the black color usually characteristic of it. At the side of the wagon road about three-quarters of a mile northeast of Brooks it has a pale buff color, and the following fossils were obtained from it at this locality:

Station 25B.—Brooks, Ky.

Chonetes scitulus, *Leiorhynchus quadricostata ?*, *Lingula spatulata* a.

Station 25C.—The New Providence shale is well exposed by extensive washes on the side of Button mould knob, about two miles north of Brooks. This has been a well-known collecting ground for many years and the rarer species are very scarce. The following were found here:

Athyris lamellosa ? r, *Aulopora* sp. a, *Camarotœchia* sp., *Chonetes illinoisensis* c, Crinoid stems a, *Orthothetes crenistria* r, *Platyceras* sp. a, *Productella pyxidata*, *Rhipidomella oweni* a, *Spirifer marionensis ?* c, *Spirifer mortonanus* r, *Spirifer suborbicularis* c, *Spiriferina* sp. c, *Strombodes striatus*, *Zaphrentis* sp. a.

The massive Riverside sandstone which caps this knob appears to be entirely barren of fossils. But in the beds of the same horizon the following fauna was found west of Brooks:

Station 25D.—Riverside sandstone one mile west of Brooks.

Camarotœchia sappho c, *Cypricardinia sp.* r, *Derbya keokuk* c, *Discina* sp. r, *Fenestella* sp. c, *Orthothetes crenistria* r, *Productus burlingtonensis* c, *Syringothyris typa* c.

DEER LICK KNOB, BULLITT COUNTY, KENTUCKY.

Northwest of Charmount, at Deer Lick knob, is the following section:

Blue clay shale	35 ft.
Thin bedded crinoidal limestone	5 ft.
Black shale	15 ft.
Devonian limestone	3 ft.

The thin limestone formation of this section at the top of the Black shale is of particular interest because it occupies the same stratigraphic horizon as the Rockford limestone thirty miles to the west and carries the typical New Providence shale fauna, which is entirely unlike that of the Rockford limestone. The following species were obtained from it:

Station 26D.—Deer Lick knob, Bullitt county, Kentucky.

Rhipidomella oweni a, *Spirifer mortonanus* c, *Spirifer suborbicularis* c.

The blue clay shale beds here have the usual characteristics of the New Providence shale, but contain very few fossils. None of these species occur in the Kinderhook fauna which occupies this horizon in southern Indiana.

LEBANON JUNCTION, KENTUCKY.

The New Providence shale is exposed on the sides of the knobs near Lebanon Junction and the following species were obtained:

Station 26D.—Northwest of Lebanon Junction one-half mile.

Athyris lamellosa a, *Chonetes illinoisensis r*, *Dielasma bovidens ?* r, *Productus semireticulatus* c, *Spirifer* sp. r, *Spirifer marionensis* r, *Spirifer mortonanus* c, *Zaphrentis dalei* E. and H. a.

The absence, or at least the scarcity, of *Rhipidomella oweni* at this station is rather surprising, since it is usually the most abundant species in these beds.

NEW HAVEN, KENTUCKY.

The Devonian limestone was not seen at New Haven and if present there is very thin. The section below is exposed just west of the town on the bank of Rolling Fork.

Black shale	5 ft.
Covered	4 ft.
Dolomitic limestone	7 ft.

The Dolomitic limestone of the above section furnished the following Niagara species:

Station 27.—New Haven, Kentucky.

Calymene niagarensis c, *Dalmanites verrucosus* r.

About five miles south of New Haven the following section is exposed along the pike at Muldrow's hill:

Covered	10	ft.
Shelly limestone and shale	20	ft.
Shale	3-5	ft.
Limestone	20	ft.
Sandstone	9	ft.
Limestone	20	ft.
Sandstone	9	ft.
Limestone	18	ft.
Bluish sandstone weathering shelly	40	ft.
Blue shelly sandstone	15	ft.
Shelly sandstone and sale	15	ft.

The above section shows the interpolation of the Lower Carboniferous limestone beds in the Riverside sandstone.

The following section shows a similar interstratification of the limestone and sandstone beds.

Section two miles southwest of New Haven:

Shelly sandstone	8 ft.
Limestone	20 in.
Grey sandy shale	10 ft.
Limestone and shale	18 ft.
Covered (mostly shale?)	60 ft.
Blue clay shale	10 ft.
Iron ore concretions	4 in.
Black shale	10 ft.

No fossils were seen in the blue clay shale of the above section except Crinoid stems.

RILEY'S, KENTUCKY.

The Lower Silurian limestone outcrops about one hundred yards northwest of the station with a dip of 10°—15° toward the southwest. The Black shale is exposed in the cut at the station. A short distance northwest of this it was found resting unconformably on rocks which are probably of Niagara age, though no fossils were found by which to settle this point.

Station 28B.—Just south of the station in the sandy shales at the top of the hill the following species were collected about ninety feet above the Black shale:

Camarotœchia sappho r, *Chonetes illinoisensis* a, *Cypricardinia* sp. c, *Hemipronites crenistria* c, *Macrodon newarkensis?* r, *Palæoneilo bedfordensis r*, *Productus burlingtonensis* c, *Productus semireticulatus* c, *Productus shumardianus* a, *Productus punctatus* r, *Schizophoria* sp. r, *Spirifer* sp. r, *Spirifer marionensis* r, *Spirifer subelliptica* c, *Streblopteria* sp. r, *Syringothyris texta* r.

PARKSVILLE, KENTUCKY.

About three-quarters of a mile west of Parksville the Black shale rests directly on the Lower Silurian. The following Lower Silurian species were collected from the bluish shelly sandstone just below the Black shale:

Murchisonia sp. c, *Platystrophia crassa* r, *Platystrophia lynx* c.

The Black shale about Parksville is about twenty-five feet thick. No fossils were found in the blue clay shale above the Black shale here.

In the Riverside sandstone the following fauna was found about 125 feet above the Black shale:

Station 28B.—Old sandstone quarry one and one-half miles west of Parksville.

Camarotœchia sp. r, *Cryptonella eudora* c, *Eumentria* sp. r, *Hemipronites crenistria* c, *Platyceras lodense* r, *Productus alternatus* r, *Productus schumardanus* r, *Productus semireticulatus*, *Reticularia pseudolineata* c, *Spirifer keokuk* c, *Spirifer lateralis ?* r.

CRAB ORCHARD, KENTUCKY.

The Devonian limestone appears to be entirely absent in the vicinity of Crab Orchard. The following connected section includes the lowest beds observed in the vicinity of the springs and those outcropping in the knobs southwest of the town.

Section at Crab Orchard:

Shelly sandstone	50	ft.
Shelly crinoidal limestone	3-4	ft.
Shelly sandstone and clay shale (partly covered)	100	ft.
Black shale	35	ft.
Buff to brownish fine grained sandstone	10	ft.

No fossils were found in the fine grained sandstone below the Black shale.

The shelly sandstone of the Riverside formation furnished the following fauna:

Station 28B.—Two Tree knob, two miles southwest of Crab Orchard.

Athyris lamellosa c, *Camarotœchia contracta?* c, *Chonetes illinoisensis* c, *Conocardium pulchellum* c, *Cypricardinia* sp. c, *Edmondia* n. sp. r, *Loxonema* nov. sp. r, *Phæthonides* sp. r, *Platyceras* sp. r, *Platyceras hertzeri?* r, *Productus* sp., *Proetus auriculatus* r, *Ptychospira sexplicata?* r, *Reticularia pseudolineata* r, *Sphenotus* sp. r, *Spirifer mortonanus* c, *Spirifer suborbicularis* c, *Spiriferina subelliptica* c, *Syringothyris texta* c, *Zaphrentis* sp. r.

PART III.

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SYSTEMATIC LIST, SHOWING RANGE AND DISTRIBUTION OF SPECIES*.

	Jeffersonville limestone and Sellersburg beds.	New Albany shale.	Rockford limestone.	New Providence shale.	Riverside sandstone.
Protozoa.					
Mœllerina greenei Ulrich, Falls of the Ohio (E. O. Ulrich)................................	x	...	...	...	...
Palæacis enormis Meek and Worthen, Rockford, Ind. (Meek and Worthen)..........	...	...	x	...	...
Cœlenterata.					
Acervularia davidsoni E. and H., 11†, Jeffersonville (White)........	x	...	...	...	...
*Acrophyllum oneidaense Billings, 12, Falls of the Ohio (W. J. Davis)..................	x	...	...	...	...
*Alveolites goldfussi Billings, 11, Louisville, Ky. (W. J. Davis)........................	x	...	...	...	...
*Alveolites indianensis Hall, 11, Louisville, Ky..	x	..	...	...	...
Alveolites labiosus Billings, Falls of the Ohio (Rominger)..	x	...	...	...	...
*Alveolites megastoma Winch., Falls of the Ohio (W. J. Davis)..........................	x	...	...	...	...
Amplexus? rockfordensis M. and G., Rockford (Miller and Gurley)....................	...	...	x	...	...
*Amplexus yandelli Milne E., 11, Falls of the Ohio, Madison (Rominger) (Cornett)	x	...	...	...	...

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*Species preceded by a star are included in the published lists of fossils in the Indiana State Museum (16th Ann. Rept. Ind. Dept. Geol. and Nat. Res.). Species or localities included on the authority of others have been followed by the name of the authority in parenthesis.

†Numbers following the names of species refer to the Reports of the In-

The following Cœlenterates are from the Jeffersonville limestone and Sellersburg beds except when otherwise indicated:

*Astræospongia hamiltonensis M. and W.,
Clark county.

Aulacophyllum convergens Hall, 12,
Falls of the Ohio,
Clark county.

Aulacophyllum cruciforme Hall, 12,
Falls of the Ohio.

Aulacophyllum insigne,
Falls of the Ohio (W. J. Davis).

Aulacophyllum pinnatum Hall, 12,
Falls of the Ohio.

Aulacophyllum poculum Hall, 12,
Falls of the Ohio.

Aulacophyllum præciptum Hall, 12,
Falls of the Ohio.

Aulacophyllum princeps Hall, 12,
Falls of the Ohio.

Aulacophyllum prateriforme Hall, 12,
Falls of the Ohio.

Aulacophyllum reflexum Hall, 12,
Indiana.

*Aulacophyllum sulcatum d'Orb.,
Louisville, Ky. (W. J. Davis).

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diana Geological Survey which contain the authority for some of the localities cited. They have been numbered as follows:

1.	Geol.	Rept.	of	Ind.,	1837-38	11.	Geol,	Rept.	of	Ind.,	1881
2.	"	"	"	"	1859-60	12.	"	"	"	"	1882
3.	"	"	"	"	1869	13.	"	"	"	"	1883
4.	"	"	"	"	1872	14.	"	"	"	"	1884
5.	"	"	"	"	1873	15.	"	"	"	"	1885-86
6.	"	"	"	"	1874	16.	"	"	"	"	1888
7.	"	"	"	"	1875	17.	"	"	"	"	1891
8.	"	"	"	"	1876-78	18.	"	"	"	"	1893
9.	"	"	"	"	1879	19.	"	"	"	"	1894
10.	"	"	"	"	1880	20.	"	"	"	"	1895

Aulacophyllum tripinnatum Hall, 12,
Falls of the Ohio.

*Aulacophyllum trisulcatum Hall, 12,
Charlestown, and
Falls of the Ohio.

Aulopora cornuta,
Falls of the Ohio (W. J. Davis).

Aulopora edithana,
Falls of the Ohio (W. J. Davis).

Aulopora serpens Goldfuss,
Falls of the Ohio (W. J. Davis).

*Baryphyllum d'orbignyi E. and H.,
Charlestown.

*Blothrophyllum acuminatum ? Hall,
Falls of the Ohio.

*Blothrophyllum approximatum Mich.,
Falls of the Ohio.

*Blothrophyllum decorticatum Billings, Rominger,
Falls of the Ohio (W. J. Davis).

*Blothrophyllum promissum Hall,
Falls of the Ohio.

Bucanophyllum gracile Ulrich,
Falls of the Ohio (Ulrich).

Calamophora goldfussi,
Jennings county (Rominger).

Calcisphæra lemoni Knowlton,
Falls of the Ohio (Knowlton).

Chætetes ponderosus,
Falls of the Ohio (Rominger),
Madison (Cornett).

*Chonophyllum magnificum Billings,
Charlestown landing,
Falls of the Ohio.

*Chonophyllum ponderosum Rominger,
Charlestown.

Cladopora alpenensis Rominger,
Falls of the Ohio (W. J. Davis).

*Cladopora aspera Rominger,
Falls of the Ohio.

Cladopora billingsi,
Louisville, Ky. (W. J. Davis).

*Cladopora cryptodens Bill.,
Falls of the Ohio.

*Cladopora expatiata Rominger,
Falls of the Ohio (W. J. Davis).

*Cladopora fischeri Billings,
Falls of the Ohio,
Charlestown landing (Rominger).

Cladopora francisci,
Falls of the Ohio (W. J. Davis).

*Cladopora imbricata Rominger,
Falls of the Ohio (Rominger), (Davis).

Cladopora iowensis,
Falls of the Ohio (W. J. Davis).

*Cladopora labiosa Billings,
Falls of the Ohio (W. J. Davis).

Cladopora lichenoides Rominger,
Falls of the Ohio (Rominger).

Cladopora linneana Rominger, 11,
Shelby county.

*Cladopora ornata Rominger,
Clark county.

Cladopora pinguis,
Falls of the Ohio (W. J. Davis).

Cladopora pulchra Rominger,
Falls of the Ohio (W. J. Davis).

Cladopora rimosa Rominger,
Falls of the Ohio (W. J. Davis).

*Cladopora robusta Rominger,
Falls of the Ohio (W. J. Davis), (Rominger).

Cladopora roemeri,
Louisville, Ky. (W. J. Davis).

*Clisiophyllum conigerum Rominger, 12,
Falls of the Ohio.

Clisiophyllum oneidaense Billings, 11. (See Acrophyllum oneidaense.)

*Cœnostroma monticulifera Winch. (Stromatopora monticulifera),
Falls of the Ohio.

*Coleophyllum pyriforme Hall, 12,
Falls of the Ohio (Hall).

*Crepidophyllum archiaci Bill.,
Falls of the Ohio.

*Cyathophyllum arctifossa Hall, 12,
Falls of the Ohio.

*Cyathophyllum brevicorne Rominger,
Falls of the Ohio (W. J. Davis).

Cyathophyllum cæspitosum Goldfuss,
Madison (Cornett).

Cyathophyllum colligatum,
Louisville, Ky. (W. J. Davis).

Cyathophyllum coralliferum,
Falls of the Ohio (W. J. Davis).

*Cyathophyllum corniculum Milne Ed., 11,
Falls of the Ohio (W. J. Davis).
Shelby county.

*Cyathophyllum davidsoni Milne E.,
Falls of the Ohio (W. J. Davis),
Shelby county.

Cyathophyllum depressum Hall,
Falls of the Ohio (Jas. Hall).

Cyathophyllum exiguum,
Falls of the Ohio (W. J. Davis).

*Cyathophyllum geniculatum Rominger,
Bartholomew county.

Cyathophyllum halli,
Falls of the Ohio (W. J. Davis).

*Cyathophyllum houghtoni Rominger,
Hartsville.

Cyathophyllum impositum Hall,
Falls of the Ohio (Jas. Hall).

*Cyathophyllum juvene Rominger,
Louisville, Ky. (W. J. Davis),
Shelby county.

Cyathophyllum radicula Rominger,
Charlestown (Rominger),
Louisville, Ky. (W. J. Davis).

*Cyathophyllum robustum,
Falls of the Ohio (W. J. Davis).

*Cyathophyllum rugosum Milne Edwd., 12,
Jennings county,
Falls of the Ohio (Rominger).
Jackson county, and
Madison.

*Cyathophyllum scyphus Rominger, 11,
Louisville, Ky. (W. J. Davis),
Shelby county.

*Cyathophyllum tornatum,
Louisville, Ky. (W. J. Davis).

*Cyathophyllum validum Hall,
Falls of the Ohio.

Cyathophyllum vesiculatum Hall,
Falls of the Ohio (Jas. Hall).

Cyclospongia discus Miller,
Bunker Hill.

*Cystiphyllum americanum E. and H.,
Clark county.

Cystiphyllum cuyagaensis,
Louisville, Ky. (W. J. Davis).

Cystiphyllum grande,
Falls of the Ohio (W. J. Davis).

Cystiphyllum greenei Miller, 18,
Falls of the Ohio.

Cystiphyllum pustulatum Hall,
Falls of the Ohio (Hall).

*Cystiphyllum squamosum,
Falls of the Ohio (W. G. Davis).

*Cystiphyllum sulcatum Billings, 11,
Falls of the Ohio (Rominger).

*Cystiphyllum vesiculosum Goldf., 11,
Falls of the Ohio (W. J. Davis).

Dendropora alterans,
Louisville, Ky. (W. J. Davis).

Dendropora neglecta,
Falls of the Ohio (Rominger),
Louisville, Ky. (W. J. Davis).

Dendropora proboscidialis,
Falls of the Ohio (W. J. Davis).

Diphyphyllum adnatum Hall, 12,
Falls of the Ohio.

*Diphyphyllum apertum Hall, 12,
Falls of the Ohio.

Diphyphyllum archiaci Bill., 11,
Louisville, Ky. (W. J. Davis),
Shelby county.

*Diphyphyllum colligatium,
Falls of the Ohio (Bill.).

Diphyphyllum gigas,
Falls of the Ohio (W. J. Davis).

Diphyphyllum simcœnse Billings, 11,
Falls of the Ohio (W. J. Davis).

*Diphyphyllum stramineum Billings, 12,
Falls of the Ohio.

Diphyphyllum strictum,
Falls of the Ohio (W. J. Davis and Nicholson).

Diphyphyllum panicum,
Louisville, Ky. (W. J. Davis).

Diphyphyllum tumidulum Hall, 12,
Falls of the Ohio.

Diphyphyllum verneuilanum,
Louisville, Ky. (W. J. Davis).

Drymopora intermedia,
Falls of the Ohio (W. J. Davis).

Drymopora nobilis,
Falls of the Ohio (W. J. Davis).

Emmonsia cylindrica, 8,
Madison (Cornett).

Emmonsia hemispherica Troost, 8,
Madison,
Carroll county (Cornett).

Eridophyllum arundinaceum. (See Diphyphyllum arundinaceum.)

*Eridophyllum strictum Edwards and Haine. (See Diphyphyllum simcoense.)

*Favosites canadensis Billings, 11,
Falls of the Ohio (W. J. Davis).
Shelby county.

*Favosites cavernosus Rominger,
Falls of the Ohio.

*Favosites clausus Rominger, 11,
Falls of the Ohio (Rominger), (Davis).

*Favosites digitatus Rominger,
Louisville, Ky. (W. J. Davis).

*Favosites emmonsi Rominger, 12,
Louisville,
Charlestown,
Falls of the Ohio (W. J. Davis).

*Favosites epidermatus Rominger, 11,
Falls of the Ohio,
Bartholomew county.

*Favosites fibrosus,
Madison (Cornett).

Favosites gothlandicus Lamark, 8,
Madison.

*Favosites hemisphericus Y. and S.,
Falls of the Ohio.

Favosites intertextus Rominger,
Falls of the Ohio (Davis).

*Favosites limitaris Rominger, 12,
Falls of the Ohio (Rominger).

Favosites maximus Troost,
Falls of the Ohio (Rominger).

*Favosites placenta Rominger,
Falls of the Ohio (Davis).

*Favosites pleurodictyoides Nicholson,
Charlestown.

Favosites polymorpha Goldfuss, 11,
Madison.

*Favosites radiatus Rominger,
Falls of the Ohio.

*Favosites radiciformis Rominger,
Falls of the Ohio (Davis).

Favosites ramosus, 8,
Madison.

*Favosites tuberosus Rominger,
Charlestown,
Falls of the Ohio (Rominger).

*Favosites turbinatus Billings,
Falls of the Ohio.

Favosites winchelli Rominger,
Falls of the Ohio (Rominger).

*Fistulipora acervulosa Rominger,
Falls of the Ohio.

Fistulipora canadensis Billings, 11,
(Rominger).

Fistulipora intercellata Hall,
Falls of the Ohio (Hall).

Glossotrypa paliformis Hall,
Falls of the Ohio (Hall).

*Hadrophyllum d'orbignyi,
Louisville, Ky.,
Clark county (W. J. Davis).

Heliolites pyriformis Guettard,
Louisville, Ky. (W. J. Davis).

Heliolites subtubulatus McCoy,
Louisville, Ky. (W. J. Davis).

Heliophyllum annulatum Hall, 12,
Scott county, and
Clark county.

Heliophyllum compactum Hall, 12,
Falls of the Ohio,

Heliophyllum corniculum Hall, 12,
Falls of the Ohio.

Heliophyllum denticulatum Hall, 12,
Falls of the Ohio.

Heliophyllum distans Hall, 12,
Falls of the Ohio.

Heliophyllum equum Hall, 12,
Falls of the Ohio.

*Heliophyllum exiguum Billings, 11,
Falls of the Ohio,
Shelby county.

Heliophyllum fecundum Hall, 12,
Falls of the Ohio.

*Heliophyllum gemmatum Hall, 12,
Falls of the Ohio.

*Heliophyllum gemmiferum Hall,
Falls of the Ohio.

*Heliophyllum halli E. and H., 12,
Falls of the Ohio.

Heliophyllum incrassatum Hall, 12,
Falls of the Ohio.

Heliophyllum invaginatum Hall, 12,
Falls of the Ohio.

Heliophyllum latericrescens Hall, 12,
Falls of the Ohio.

Heliophyllum nettlerothi Hall, 12,
Falls of the Ohio.

Heliophyllum sordidum Hall, 12,
Falls of the Ohio.

*Heliophyllum parvum Hall, 12,
Falls of the Ohio.

*Heliophyllum scyphulus Hall, 12,
Charlestown.

*Heliophyllum tenuimurale Hall, 12,
Falls of the Ohio.

Hydrophyllum orbignyi, 8,
Madison.

Intrepora preteolata Hall,
Falls of the Ohio (Hall).

Lichenalia alternata Hall,
Falls of the Ohio.

Lichenalia (Odontotrypa) alveata Hall,
Falls of the Ohio (Hall.).

Lichenalia bistriata Hall,
Falls of the Ohio.

Lichenalia (Selenopora) circincta Hall,
Falls of the Ohio (Hall).

Lichenalia (Selenopora) complexa Hall,
Falls of the Ohio (Hall).

Lichenalia conulata Hall,
Falls of the Ohio (Hall),

Lichenalia geometrica Hall,
Falls of the Ohio (Hall).

Lichenalia ovata Hall,
Falls of the Ohio (Jas. Hall).

Lichenalia (Pileotrypa) pyrisormis Hall,
Falls of the Ohio (Hall).

Lichenalia subcava Hall,
Falls of the Ohio (Hall).

Lichenalia substellata Hall,
Falls of the Ohio (Jas. Hall).

*Michelinia clappi (Milne E.) Rominger,
Falls of the Ohio (Rominger).

*Michelinia convexa,
Falls of the Ohio (d'Orbigne).

*Michelinia cylindrica E. and H.,
Falls of the Ohio (Davis).

*Michelinia favositoidea Billings,
Falls of the Ohio (Davis).

*Michelinia insignis Rominger,
Falls of the Ohio (Rominger).

*Phillipsastrea gigas,
Charlestown,

*Phillipsastrea verneuilli Milne Edw.,
Madison (Cornett).

*Phillipsastrea yandelli Rominger,
Charlestown.
Falls of the Ohio (Rominger).

Prismopora triquetra Hall,
Falls of the Ohio (Hall).

Receptaculites elrodi Miller, 18,
Hartsville.

Romingeria umbellifera,
Falls of the Ohio (W. J. Davis).

Streptelasma coarctatum Hall, 12,
Louisville, Ky.

Streptelasma inflatum Hall, 12,
Falls of the Ohio.

Streptelasma mammiferum Hall, 12,
Falls of the Ohio.

Streptelasma papillatum Hall, 12,
Falls of the Ohio.

Streptelasma simplex Hall, 12,
Falls of the Ohio.

Streptelasma tenue Hall, 12,
Falls of the Ohio.

*Striatopora cavernosa Rominger,
Falls of the Ohio (Rominger).

Striatopora huronensis Rominger,
Falls of the Ohio (Davis).

Striatopora linneana Billings, 11,
Falls of the Ohio (Rominger).

*Stromatopora concentrica Goldfuss,
Madison (Cornett).

*Stromatopora constellata Hall,
Falls of the Ohio.

*Stromatopora densum Nich., 12,
Charlestown,

*Stromatopora granulata Nich.,
Falls of the Ohio,

*Stromatopora mammillata Nich.,
Clark county.

*Stromatopora nodulata Nich.,
Shelby county,
Clark county.

*Stromatopora substriatella Nich.,
Falls of the Ohio.

Syringopora bouchardi,
Falls of the Ohio (W. J. Davis).

*Syringopora hisingeri Billings,
Falls of the Ohio (Rominger).

*Syringopora malcurii Billings, 11,
Falls of the Ohio.

*Syringopora perelegans Billings, 11 and 12,
Falls of the Ohio (W. J. Davis).

*Syringopora tabulata E. and H.,
Madison, and
Falls of the Ohio (Rominger).

*Syringopora tubiporoides Y. and S.,
Madison (Cornett),
Falls of the Ohio (W. J. Davis).

*Thecia ramosa Rominger,
Falls of the Ohio (Rominger).

Zaphrentis compressa Rominger, 12,
Falls of the Ohio (W. J. Davis).

Zaphrentis concava Hall, 12,
Falls of the Ohio.

Zaphrentis conigera Rominger, 11,
Falls of the Ohio (Rominger).

*Zaphrentis convoluta Hall, 12,
Falls of the Ohio.

*Zaphrentis cornicula Leseur,
Falls of the Ohio.
Charlestown (Rominger),
Madison.

Zaphrentis (Amplexus) cruciforme Hall, 12,
Falls of the Ohio.

Zaphrentis cyathiformis Hall, 12,
Falls of the Ohio.

*Zaphrentis dalei E. and H. - - **New Providence Shale.**
Harrison county (Collett).

*Zaphrentis davisana Miller,
Falls of the Ohio.

Zaphrentis deformis Hall, 12,
Charlestown.

*Zaphrentis duplicata Hall, 12,
Falls of the Ohio.

*Zaphrentis elegans Hall, 12,
Falls of the Ohio.

*Zaphrentis exiguum Billings,
Falls of the Ohio.

*Zaphrentis foliata Hall, 12,
Falls of the Ohio.

*Zaphrentis gigantea Rafinesque, 11,
Madison,
Jennings county,
Falls of the Ohio (Rominger).

*Zaphrentis herzeri Hall, 12,
Charlestown.

Zaphrentis ida Win. - - - - - **Rockford limestone.**
Rockford (Winchell).

*Zaphrentis nitida Hall, 12,
Falls of the Ohio.

Zaphrentis nodulosa Rominger,
Falls of the Ohio (W. J. Davis).

Zaphrentis ovalis Hall, 12,
Falls of the Ohio.

Zaphrentis planima Hall, 12,
Falls of the Ohio.

Zaphrentis ponderosa Hall, 12,
Falls of the Ohio,

*Zaphrentis profunda Hall, 12,
Falls of the Ohio.

*Zaphrentis prolifica Billings,
Louisville, Ky. (W. J. Davis).

*Zaphrentis rafinesquei E. and H., 11,
Falls of the Ohio,
Jennings county,
Madison (W. J. Davis).

Zaphrentis subcompressa Hall, 12,
Falls of the Ohio.

Zaphrentis spira Hall, 12,
Falls of the Ohio.

Zaphrentis terebrata Hall, 12,
Falls of the Ohio.

Zaphrentis torta Hall, 12,
Falls of the Ohio, and
Clark county.

Zaphrentis trisutura Hall, 12,
Falls of the Ohio.

*Zaphrentis ungula Rominger, 12,
Falls of the Ohio (Rominger).

*Zaphrentis yandelli E. and H.,
Falls of the Ohio (W. J. Davis).

Echinodermata.

The following Echinoderms are from the Jeffersonville limestone and Sellersburg beds except when otherwise indicated:

Actinocrinus coreyi Lyon and Casseday,
Washington county (L. and C.)

*Ancyrocrinus bulbosus Hall,
Falls of the Ohio.

Ancyrocrinus spinosus Hall,
Clark county.

Barycrinus sculptilis Hall (Cyathocrinus sculptilis),
Clark county.

*Catillocrinus bradleyi M. and W., 8 - **Riverside sandstone**.
Harrison county.

Codaster americanus Shumard,
Falls of the Ohio (Shumard).

Codaster attenuatus Lyon,
Falls of the Ohio (Lyon).

Codaster pyramidatus Shumard,
Falls of the Ohio (Shumard).

Dolatocrinus amplus Miller and Gurley,
Charlestown (M. and G.).

Dolatocrinus aplatus M. and G.,
Charlestown (M. and G.).

Dolatocrinus approximatus M. and G.,
Louisville, Ky. (M. and G.).

Dolatocrinus argutus M. and G.,
Charlestown (M. and G.).

Dolatocrinus bellulus M. and G.,
Charlestown (M. and G.).

Dolatocrinus bellarugosus M. and G.,
Charlestown (M. and G.).

Dolatocrinus bulbaceus M. and G.,
Charlestown (M. and G.).

Dolatocrinus cælatus M. and G.,
Charlestown (M. and G.).

Dolatocrinus charlestownensis M. and G.,
Charlestown (M. and G.).

Dolatocrinus corporosus M. and G.,
Charlestown (M. and G.).

Dolatocrinus exornatus M. and G.,
Charlestown (M. and G.).

Dolatocrinus grandis M. and G.,
Louisville, Ky. (M. and G.).

Dolatocrinus greenei M. and G.,
Louisville, Ky. (M. and G.).

Dolatocrinus indianensis M. and G.,
Charlestown (M. and G.)

Dolatocrinus lacus Lyon,
Falls of the Ohio, and
Silver Creek, Clark county (Lyon).

Dolatocrinus lineolatus M. and G.,
Charlestown (M. and G.).

Dolatocrinus magnificus M. and G.,
Falls of the Ohio (M. and G.).

Dolatocrinus marshi Lyon,
Falls of the Ohio, and
Charlestown.

Dolatocrinus neglectus M. and G.,
Charlestown (M. and G.).

Dolatocrinus nodosus M. and G.,
Charlestown (M. and G.).

Dolatocrinus ornatus var. asperatus M. and G.,
Charlestown (M. and G.).

Dolatocrinus pulchellus M. and G.,
Charlestown (M. and G.).

Dolatocrinus sacculus M. and G.,
Charlestown (M. and G.).

Dolatocrinus salebrosus M. and G.,
Charlestown (M. and G.).

Dolatocrinus spinosus M. and G.,
Charlestown (M. and G.).

Dolatocrinus stellifer M. and G.,
Louisville, Ky. (M. and G.).

Eleutherocrinus cassedayi Y. and S.,
Clark county.

Eretmocrinus originarius Wach. and Spr.,
Bono (Wach. and Springer).

Gennæocrinus cornigerus L. and C. (Actinocrinus kentuckensis),
Clark county.

Gilbertsocrinus greenei M. and G.,
Charlestown (M. and G.).

Gilbertsocrinus indianensis M. and G.,
Charlestown (M. and G.).

Ichtyocrinus spinosulus M. and G.,
Clark county (M. and G.).

Megistocrinus abnormis Lyon (Actinocrinus abnormis),
Clark county, and
Falls of the Ohio (Lyon).

Megistocrinus expansus M. and G.,
Louisville, Ky. (M. and G.).

Megistocrinus hemisphericus M. and G.,
Clark county (M. and G.).

Megistocrinus knappi Lyon and Cassady,
Falls of the Ohio (Lyon).

Megistocrinus ornatus M. and G.,
Clark county (M. and G.).

Megistocrinus rugosus L. and C.,
Clark county,
Falls of the Ohio.

Megistocrinus spinulosus Lyon,
Falls of the Ohio (Lyon).

Nucleocrinus angularis Lyon (Olivanites angularis),
Falls of the Ohio.

Nucleocrinus greenei M. and G.,
Louisville, Ky. (M. and G.).

*Nucleocrinus verneuili Troost (Olivanites verneuili),
Falls of the Ohio.

Nucleocrinus venustus M. and G.,
Louisville, Ky. (M. and G.).

*Platycrinus leai Lyon,
Jeffersonville.

Poteriocrinus davisanus Miller,
Deputy (Miller).

Poteriocrinus nettlerothanus Miller,
Deputy (Miller).

Sabatocrinus swallovi Hall, 8,
Harrison county.

Synbathocrinus oweni Hall, - - - **Rockford limestone.**
Rockford (Jas. Hall).

Vasocrinus sculptus Lyon,
Falls of the Ohio (Lyon).

Vermes.

The following worm is from the Jeffersonville limestone and Sellersburg beds:

Conulites elevata Cozzens,
(Cozzens).

Molluscoidea.

BRYOZOA.

The following Bryozoa are from the Jeffersonville limestone and Sellersburg beds except when otherwise indicated:

Buscopora lunata Rominger (Buscoporà dentata) Ulrich,
Falls of the Ohio (Ulrich).

Cosinatrypa cribriformis var. carinata Hall,
Falls of the Ohio (Hall).

Cystopora geniculata Hall,
Falls of the Ohio (Hall).

Discotrypa devonica Ulrich,
Falls of the Ohio (Ulrich).

Eridopora minima Ulrich,
Falls of the Ohio (Ulrich).

Fenestella (Unitrypa) acaulis Hall. (See Unitrypa acaulis.)

Fenestella (Polypora) aculeata Hall,
Falls of the Ohio (Hall).

Fenestella bifurca Ulrich,
Falls of the Ohio (A. E. Ulrich).

Fenestella bigeneris Ulrich,
Falls of the Ohio "

Fenestella imbricata Hall,
Falls of the Ohio (Hall).

Fenestella biserrulata Hall,
Falls of the Ohio "

Fenestella confertipora Hall,
Falls of the Ohio "

Fenestella (Hemitrypa) cribrosa Hall,
Falls of the Ohio "

Fenestella cultrata Hall,
Falls of the Ohio "

Fenestella curvijunctura Hall,
Falls of the Ohio "

Fenestella depressa Hall,
Falls of the Ohio "

Fenestella equalis Hall,
Falls of the Ohio "

Fenestella interrupta Hall,
Falls of the Ohio "

Fenestella latijunctura Hall,
Falls of the Ohio "

Fenestella lunulata Hall,
Falls of the Ohio "

Fenestella patellifera Ulrich,
Falls of the Ohio (A. E. Ulrich).

Fenestella perplexa Hall,
Falls of the Ohio (Hall).

Fenestella permarginata Hall,
Falls of the Ohio (Hall).

Fenestella pertenuis Hall, 11,
Falls of the Ohio.

Fenestella plumosa Prout. (See Hemitrypa plumosa.)

Fenestella (Unitrypa) projecta Hall,
Falls of the Ohio (Hall).

Fenestella pulchella Ulrich,
Falls of the Ohio (A. E. Ulrich).

Fenestella (Polypora) quadrangularis Hall,
Falls of the Ohio (Hall).

Fenestella sculptilis Ulrich,
Falls of the Ohio (A. E. Ulrich).

Fenestella semirotunda Hall,
Falls of the Ohio (Hall).

Fenestella serrata Hall,
Falls of the Ohio "

Fenestella singularitas Hall,
Falls of the Ohio "

Fenestella stellata Hall,
Falls of the Ohio "

Fenestella tenella Hall,
Falls of the Ohio "

Fenestella (Unitrypa) transversa Hall,
Falls of the Ohio "

Fenestella variapora Hall,
Falls of the Ohio "

Fenestella verrucosa Hall,
Falls of the Ohio "

Fistulipora normalis Ulrich,
Falls of the Ohio (Ulrich).

Hiderella canadensis Hall,
Falls of the Ohio (Hall).

Lichenotrypa cavernosa Ulrich,
Falls of the Ohio (Ulrich).

Orthopora rhombifera Hall (Trematopora (Orthopora) rhombifera),
Falls of the Ohio.

Phractopora cristata Hall,
Falls of the Ohio (Hall).

Phractopora cristata var. lineata Hall,
Falls of the Ohio.

Pileotrypa clivulata Hall,
Falls of the Ohio (Hall).

Pileotrypa denticulata Hall,
Falls of the Ohio.

Polypora adnata Hall (Fenestella (Polypora) adnata),
Falls of the Ohio.

Polypora blandida Ulrich,
Falls of the Ohio (Ulrich).

Polypora celsipora var. minima Hall (Fenestella celsipora var. minima),
Falls of the Ohio (Hall).

Polypora quadrangularis Hall (Fenestella (Polypora) quadrangularis),
Falls of the Ohio (Hall).

Polypora transversa Ulrich,
Falls of the Ohio (A. E. Ulrich).

Scalaripora scalariformis Hall,
Falls of the Ohio (Hall).

Scalaripora subconcava Hall,
Falls of the Ohio.

Semicoscinium infraporosa Ulrich,
Falls of the Ohio (A. E. Ulrich).

Semicoscinium obliquatam Ulrich,
Falls of the Ohio (A. E. Ulrich).

Semicoscinium rhomboideum Prout,
Falls of the Ohio (Prout).

Semicoscinium tuberculatum Prout,
Falls of the Ohio "

Stictopora gilberti (Meek) Ulrich,
Falls of the Ohio.

Stictopora ovatipora Hall,
Falls of the Ohio.

Stictopora vermicula Hall,
Falls of the Ohio (Hall).

Trematella annulata (Trematopora (Trematella) annulata),
Falls of the Ohio (Hall).

Trematopora (Trematella) arborea "
Falls of the Ohio "

Trematopora hirsuta Hall,
Clark county.

Trematopora (Orthopora) regularis "
Falls of the Ohio "

Unitrypa acaulis (Fenestella (Unitrypa) acaulis)
Falls of the Ohio (Hall).

Unitrypa conferta Ulrich,
Falls of the Ohio (A. E. Ulrich).

Unitrypa fastigata Hall (Fenestella (Unitrypa) fastigata),
Falls of the Ohio (Hall).

Unitrypa retrorsa Ulrich,
Falls of the Ohio (A. E. Ulrich).

Unitrypa stipata Hall (Fenestella (U.) stipata),
Falls of the Ohio (Hall).

Unitrypa tegulata Hall (Fenestella (U.) tegulata),
Falls of the Ohio (Hall).

Brachiopoda.	Jeffersonville limestone and Sellersburg beds.	New Albany shale.	Rockford limestone.	New Providence shale.	Riverside sandstone.
*Athyris fultonensis (Swallow) Falls of the Ohio, Charlestown landing (Nettleroth), Watson, Kent, Charlestown, Sellersburg, Lexington, Ind.	x	.	.	.	.
Ambocœlia gregaria Hall Common at Crothersville and Guinea Knobs, Ind.	.	.	x	.	.
*Ambocœlia umbonata Con Abundant at Huber, Ky., Louisville (Nettleroth).	x	.	.	.	.
Athyris incrassata Hall ? One or two specimens from Bartel, Ind., are referred to this species.	.	.	.	.	x
Athyris lamellosa (L'Eveillé) Common in New Provldence shale at Pixley Knob, Ind., and Lebanon Junction, Ky. Occurs in the Riverside sandstone at Crab Orchard, Ky.	.	.	.	x	.
*Athyris spiriferoides Eaton Utica, Clark county, and Charlestown (Hall), Huber, Ky.	x	.	.	.	.
Atrypa ellipsoidea Nettleroth Falls of the Ohio (Nettleroth.	x	.	.	.	.
*Atrypa reticularis Linn Abundant at Lexington, Utica, Clark county, Falls of the Ohio, Charlestown (Hall), Sellersburg, Watson, Ind., Bear Grass creek, Louisville, Ky., Lancaster, Paris Crossing, Kent, Brooks, Ky.	x	.	.	.	.

*Atrypa spinosa Hall Rare at Falls of the Ohio, Charlestown, Clark county (Nettleroth).	x	.	.	.	.
Barriosella subspatulata (Meek and Worthen) Rockford, Ind. (Hall and Clark).	.	x	.	.	.
Camarotœchia carolina Hall Falls of the Ohio (Hall and Clark).	x	.	.	.	.
Camarotœchia congregata (Conrad) Falls of the Ohio (Hall), Watson, Ind., Lexington.	x	.	.	.	.
Camarotœchia sappho Hall Common throughout the region.	.	.	.	.	x
*Camarotœchia tethys (Bill.) Common at Falls of the Ohio, Lancaster, Kent, Watson, Bear Grass creek, Louisville, Scipio, Sellersburg, Lexington, Paris Crossing, Ind., Huber, Ky.	x	.	.	.	.
Chonetes acutiradiatus Hall Falls of the Ohio, Utica, and Clark county (James Hall), (Nettleroth).	x	.	.	.	.
Chonetes arcuatus Hall Common at Paris Crossing, Ind.	x	.	.	.	.
Chonetes coronatus Rare. Scott county, New Albany (Borden), Lexington, Ind.	x	.	.	.	.
Chonetes geniculatus White ? Abundant at Crothersville and Guinea Knobs, Ind.	.	.	x	.	.
Chonetes illinoisensis Worthen Common at Bartel and Pixley Knob, Ind., and Brooks, Lebanon Junction, Riley's, and Crab Orchard, Ky.	.	.	.	x	x
*Chonetes lepidus Hall New Albany, Scott county, Lexington, and Jennings county, Ind. (Whitfield).	.	x	.	.	.

Chonetes logani Norwood and Pratton...... Harrison county, 8. Common at Low Gap ridge, Crothersville, and Pixtey knob, Ind.	.	.	x?	x	x
Chonetes nana de Verneuil .... Falls of the Ohio (Norwood and Pratton).	x	.	.	.	.
Chonetes mucronatus Hall................. Rare. Charlestown, Falls of the Ohio, Sellersburg, Ind., Bear Grass creek, Louisville, Ky.	x	.	.	.	.
*Chonetes planumbonus M. and W......... Clark county, Washington, and Harrison counties, 8.	.	.	.	.	x
Chonetes pusillus Hall.......................... Rare. Paris crossing.	x	.	.	.	.
*Chonetes scitulus Hall....................... Brooks, Ky.	.	x	.	.	.
*Chonetes subquadrata Nettleroth........... Falls of the Ohio (Nettleroth).	x	.	.	.	.
*Chonetes yandellanus Hall................... Common. Lexington, Charlestown, Sellersburg, Falls of the Ohio, and Scipio, Ind.	x	.	.	.	.
*Conchidium knighti Nettleroth.............. Clark county (Nettleroth).	x	.	.	.	.
Cranæna romingeri Hall....................... Clark county (Nettleroth).	x	.	.	.	.
Crania greenei Miller.......................... Falls of the Ohio, 18.	x	.	.	.	.
Crania sheldoni White......................... Watson, Ind. (Nettleroth).	x	.	.	.	.
Cryptonella ? eudora Hall..................... A rather rare species in the sandstone at Brownstown and Low Gap Ridge, Ind., and Parksville, Ky.	.	.	.	.	x
Cryptonella ? inconstans....................... Rare. Guinea Knobs, Ind.	.	.	x	.	.

Cryptonella lens Hall...........................	x	.	.	.	.
Clark county (Hall and Whitfield).					
Cryptonella ovalis Miller.........................	x	.	.	.	.
Rare. Bunker Hill, 17, Falls of the Ohio.					
*Cyclorhina nobilis Hall.........................	x	.	.	.	.
Charlestown.					
Cyrtina sp..	.	.	.	x	.
An undetermined species occurs in the shale at Pixley Knob, Ind.					
Cyrtina crassa Hall...............................	x	.	.	.	.
Falls of the Ohio, Utica, Ind. (Nettleroth), (Hall).					
*Cyrtina hamiltonensis Hall (Nettleroth)..	x	.	.	.	.
Clark county. Rare. Falls of the Ohio, Scipio, Paris creek, Sellersburg, Kent, Ind.					
Cyrtina hamiltoniæ var. recta Hall..........	x	.	.	.	.
Falls of the Ohio (Nettleroth).					
*Delthyris consobrina (d'Orbigny)...........	x	.	.	.	.
Falls of the Ohio and Charlestown, Ind.					
*Delthyris raricosta Conrad....................	x	.	.	.	.
Falls of the Ohio (Hall).					
Delthyris sculptilis Hall.........................	x	.	.	.	.
Falls of the Ohio (Nettleroth).					
Derbya keokuk Hall.............................	.	.	.	x	.
Abundant in many localities. Brownstown, Edwardsville, Low Gap Ridge, Ind., Brooks, and Crab Orchard, Ky.					
Deilasma bovidens (Norton)?.................	.	.	x	.	.
A specimen from Lebanon Junction is doubtfully referred to this species.					
Eunella harmonia Hall..........................	x	.	.	.	.
Falls of the Ohio (Hall).					
*Eunella lincklæni Hall.........................	x	.	.	.	.
Falls of the Ohio (Nettleroth), Bear Grass creek, Louisville.					

Eumetria marcyi (Shumard).................. This St. Louis species has been found in a single locality—Parksville, Ky.	.	.	.	.	x
Glossina triangulata (Nettleroth)............ Falls of the Ohio (Nettleroth).	x	.	.	.	.
Leiorhynchus greeneanum (Ulrich)......... New Albany, Knobstone (Ulrich).	.	x	.	.	.
*Leiorhynchus limitare (Vanuxem)......... Scott county.	.	x	.	.	.
*Leiorhynchus quadricostatum (Vanuxem) Rare. Harrison county, New Albany, Jennings county, Scott county (Whitfield) (Nettleroth), Crothersville?, Falls of the Ohio, Brooks?, Ky.	x	x	x?	.	.
*Leptæna rhomboidalis (Wilckens)......... Common. Sellersburg, Ind.	x	.	.	.	.
Lingulodiscina sp.............................. An undetermined species occurs rarely at Low Gap Ridge.	.	.	.	.	x
Lingulodiscina newberryi (Hall)............. Rare. Brownstown, Ind.	.	.	.	.	x
Lingula ligea Hall.............................. A Lingula which appears to belong to this species occurs abundantly at Crothersville, Ind.	.	x	.	.	.
Lingula melie Hall?............................ Lebanon, Ky. (Whitfield).	.	x	.	.	.
*Lingula spatulata Vanuxem.................. Jennings county and New Albany, Lebanon, Ky. (Whitfield), Louisville, Ky.	.	x	.	.	.
*Meristella haskinsi Hall....................... Charlestown.	x	.	.	.	.
*Meristella nasuta Conrad..................... Falls of the Ohio (Nettleroth).	x	.	.	.	.
*Orbiculoidea ampla Hall....................... Rare. Charlestown and Watson, Ind. (Nettleroth).	x	.	.	.	.

Orbiculoidea doria (Hall) Clark county (Nettleroth).	x	.	.	.	.
Orbiculoidea minuta (Hall)? Lebanon, Ky.	.	x	.	.	.
*Orbiculoidea seneca (Hall) Charlestown.	x	.	.	.	.
Orthothetes chemungensis arctostriatus Hall Rare. Falls of the Ohio, Lancaster, Scipio, Kent, Bear Grass creek, Louisville.	x	.	.	.	.
*Orthothetes crenistria (Phillips?) Rather common. Low Gap Ridge, Bartel, Borden, Ind., Brooks, Riley's, and Parksville, Ky.	.	.	.	x	x
*Orthothetes umbraculum Hall and Clark New Providence, Ind., 12.	.	.	.	.	x
Parazyga hirsuta Hall Bunker Hill, 17, Falls of the Ohio (Nettleroth).	x	.	.	.	.
Pentamerella arata (Con.) Rare. Clark county, Falls of the Ohio (Hall).	x	.	.	.	.
Pentamerella pavilionensis Hall Falls of the Ohio (Nettleroth).	x	.	.	.	.
Pentamerella thusnelda Nettleroth Falls of the Ohio (Nettleroth).	x	.	.	.	.
*Pentagonia unisulcata (Con.) Falls of the Ohio (Nettleroth).	x	.	.	.	.
Pholidostrophia iowensis Owen Falls of the Ohio (Nettleroth).	x	.	.	.	.
Productus alternatus N. and P. Rare. Parksville, Ky.	.	.	.	.	x
Productus arcuatus Hall? A common species at Pixley Knob, Ind.	.	.	.	x	.
Productus burlingtonensis Hall Common. Brooks and Riley's, Ky.	.	.	.	.	x

Productus gracilis A. Winch A rare species at Pixley Knob and Borden, Ind.	.	.	.	x	x
Productus magnus Meek and Worthen "Knobstone," Harrison county (Collett).	.	.	.	.	.
Productus newberryi Hall. Common at Borden, Low Gap ridge, Bartel, and New Albany, Ind.	.	.	.	.	x
Productus punctatus (Martin) Several specimens of this Coal Measure species were found in the Waverly fauna at Riley's, Ky.	.	.	.	.	x
Productus pyxidata Hall A rather rare species at Pixley Knob, Ind., and Brooks, Ky.	.	.	.	.	x
*Productus semireticulatus (Martin) Common. Low Gap Ridge, Borden, Bartel, and Pixley Knob, Ind., Lebanon Junction, Riley's, and Parksville, Ky.	.	.	.	x	x
Productella semiglobosa Nettleroth. Falls of the Ohio (Nettleroth).	x	.	.	.	.
Productella shumardana Hall? Pixley Knob, Ind., Riley's and Parksville, Ky.	.	.	.	x	x
Productella spinulicosta Hall Falls of the Ohio, North Vernon, Paris Crossing.	x	.	.	.	.
*Productella spinulicosta Hall Rare. Charlestown, Shelby county, and Louisville (Hall and Clark), Kent, Bear Grass creek, Louisville, Ky., North Vernon, Ind.	x	.	.	.	.
*Productella subalata Hall Falls of the Ohio.	x	.	.	.	.
Ptychospira sexplicata (White and Whitf.)? A fossil doubtfully referred to this species occurs rarely at Bartel, Ind., Brooks, and Crab Orchard, Ky.	.	.	.	x	x

Reticularia pseudolineata (Hall) Common. Low Gap Ridge, Bartel, and Brownstown, Ind., Parksville and Crab Orchard, Ky.	.	.	.	.	x
Reticularia cooperensis (Swallow) Rockford (Jas. Hall).	.	.	x	.	.
Reticularia tenuispinata (Her.) One specimen from Bartel, Ind., is referred to this species.	.	.	.	.	x
*Rhipidomella burlingtonensis Hall "Knobstone," New Providence, Ind.	.	.	.	.	.
Rhipidomella goodwini (Nettleroth) Falls of the Ohio (Nettleroth).	x	.	.	.	.
*Rhipidomella leucosia Hall Charlestown.	x	.	.	.	.
*Rhipidomella livia Rare. Clark county (Nettleroth), Bear Grass creek, Louisville, Falls of the Ohio, Brooks, Ky.	x	.	.	.	.
Rhipidomella ocassus Hall ? Rockford (Hall), Crothersville, Ind.	.	.	x	.	.
Rhipidomella oweni Hall and Clark An abundant and characteristic fossil of the New Providence shale. Brooks and Clearmont, Ky.	.	.	.	x	.
*Rhipidomella vanxuemi Hall Clark county (Hall), Lexington, Ind., Brooks, Ky.	x	.	.	.	.
*Rhynchonella macra Hall Washington county, Knobstone, 12.	.	.	.	.	.
Rhynchonella louisvillensis Nettleroth Falls of the Ohio (Nettleroth).	x	.	.	.	.
Rhynchonella obsolescens Hall Rockford (Hall), and Crothersville, Ind.	.	.	x	.	.
Rhynchonella tenuistriata Nettleroth (Nettleroth).	x	.	.	.	.

*Schizophoria striatula (Scholtheim)........ Common. Lexington, Paris Crossing, Lancaster, Sellersburg, Ind., Falls of the Ohio, Bear Grass creek, Louisville.	x	.	.	.	.
Schizolobus concentrica (Vanuxem)......... Falls of the Ohio (Hall).	.	x	.	.	.
*Spirifer acuminatus Conrad, 10............. Abundant. Falls of the Ohio (Hall), and Mount Vernon, Charlestown, Scipio, Lancaster, Kent, Falls of the Ohio, Bear Grass creek, Louisville, Lexington, North Vernon, Ind.	x	.	.	.	.
*Spirifer angustus Hall........................ Charlestown, and Shelby county, 11.	x	.	.	.	.
*Spirifer arctisegmentus Hall.................. Rare. Clark county (Nettleroth), Kent, Ind., Brooks, Ky.	x	.	.	.	.
Spirifer byrnesi Nettleroth.................... Abundant. Clark county (Nettleroth), Lexington, Falls of the Ohio, Charlestown, Watson, Bear Grass creek, Louisville, Paris Crossing, Sellersburg, Ind.	x	.	.	.	.
Spirifer audaculus (Conrad).................. Louisville (Hall).	x	.	.	.	.
Spirifer davisi Nettleroth..................... Rare. Falls of the Ohio (Nettleroth), Lancaster, Ind.	x	.	.	.	.
*Spirifer divaricatus Hall...................... Rare. Clark county and Bunker Hill (Nettleroth), Brooks, Bear Grass creek, Louisville, Ky.	x	.	.	.	.
Spirifer duodenarius (Hall)................... Falls of the Ohio (Nettleroth).	x	.	.	.	.
*Spirifer euruteines Owen, 11................. Common. Falls of the Ohio (Hall), Charlestown (Nettleroth), Lexington, Lancaster, Falls of the Ohio, Watson, Sellersburg, Kent, Ind.	x	.	.	.	.

Spirifer fornacula (Hall Falls of the Ohio (Nettleroth).	x	.	.	.	.
Spirifer fimbriatus Morton Clark county (Nettleroth).	x	.	.	.	.
*Spirifer granulosus (Con.) Abundant. Sellersburg, Paris Crossing, Falls of the Ohio, Lexington, Watson, Charlestown, Ind., Brooks, and Huber, Ky.	x	.	.	.	.
*Spirifer gregarius Clapp, 10 Falls of the Ohio, Falls of the Ohio (Hall), Scott county, Clark county, Charlestown, Bear Grass creek, Louisville, Sellersburg.	x	.	.	.	.
Spirifer grieri Hall Rare. Falls of the Ohio (Nettleroth), Paris Crossing.	x	.	.	.	.
Spirifer iowensis Owen Common. Paris Crossing, Falls of the Ohio, Watson, Ind., Bear Grass creek, Louisville, Ky.	x	.	.	.	.
*Spirifer keokuk Hall Abundant at most fossiliferous localities in the Riverside sandstone. Riverside, Brownstown, Low Gap Ridge, Pixley knob, and Edwardsville, Ind., and Parksville, Ky.	.	.	.	.	x
Spirifer hobbsi Nettleroth Falls of the Ohio (Nettleroth).	x	.	.	.	.
Spirifer lateralis Hall ? Rare. Parksville.	.	.	.	x	.
Spirifer macconathei Nettleroth Falls of the Ohio (Nettleroth).	x	.	.	.	.
*Spirifer manni Hall Clark county.	x	.	.	.	.

*Spirifer marionensis Shumard, 8 Harrison county (Collett), Falls of the Ohio (Nettleroth). A small form of this species is common in the Rockford limestones at Crothersville and Guinea Knobs. Imperfect specimens from Brooks, Lebanon Junction, and Riley's, Ky., are referred to this species.	x?	.	x	x?	x?
*Spirifer mortonanus Miller Pixley knob, Ind., Brooks, Clearmont, and Crab Orchard, Ky.	.	.	.	x	x
*Spirifer mucronatus Conrad ? Clark county (Nettleroth).	x	.	.	.	.
Spirifer peculiaris Shumard "Knobstone," Harrison county (Collett).	.	.	.	.	.
Spirifer rostellatus Hall ? A few specimens from Pixley knob are doubtfully referred to this species.	.	.	x	.	.
*Spirifer segmentum Hall, 11 Rather common. Falls of the Ohio, and Charlestown landing (Hall), Sellersburg, Charlestown, Kent, Lexington, Ind.	x	.	.	.	.
Spirifer suborbicularis Hall Common. Pixley knob, Ind., Brooks, Clearmont, and Crab Orchard, Ky.	.	.	.	x	x
*Spirifer tullius Falls of the Ohio. This species has not been seen by me and is included on the authority of the Indiana State Museum catalogue.	x	.	.	.	.
*Spirifer varicosus Hall Common. Charlestown landing (Hall), Falls of the Ohio, Watson (Nettleroth), Bear Grass creek, Scipio, North Vernon, Lancaster, Lexington, Kent, Sellersburg, and Brooks, Ky., Huber, Ky.	x	.	.	.	.

Spirifer depressus Her.? Brownstown, Low Gap Ridge, and Bartel, Ind.	.	.	.	.	x
Spiriferina solidirostris White Abundant. Crothersville, Ind.	.	.	x	.	.
Spiriferina subelliptica (McChesney) Common. Riley's, Brooks, and Crab Orchard, Ky.	.	.	.	.	x
Streptorhynchus pectinaceum Hall New Albany (Hall).	.	.	.	.	x
*Stropheodonta concava Hall Rare. Charlestown and Sellersburg, Ind.	x	.	.	.	.
*Stropheodonta demissa Conrad (Con.) Common. Charlestown (Nettleroth), Lexington, Watson, Scipio, Lancaster, Falls of the Ohio, North Vernon, Bear Grass creek, Sellersburg, Paris Crossing, Kent.	x	.	.	.	.
*Stropheodonta hemispherica Hall Common. Falls of the Ohio (Hall), Clark county, Sellersburg, Lancaster, Charlestown, Lexington, North Vernon, Watson, Kent, Bear Grass creek.	x	.	.	.	.
*Stropheodonta inequistriata (Conrad) Rare. Falls of the Ohio (Nettleroth), Bear Grass creek, Charlestown.	x	.	.	.	.
Stropheodonta perplana (Conrad) Abundant. Falls of the Ohio (Nettleroth), Scipio, Lancaster, Kent, North Vernon, Watson, Bear Grass creek, Sellersburg, Charlestown, Paris Crossing, Crothersville, Ind., Brooks, Ky.	x	.	.	.	.
Stropheodonta plicata Hall Falls of the Ohio (Nettleroth).	x	.	.	.	.
*Syringothyris carteri (Hall) "Knobstone," Washington and Clark counties.	.	.	.	.	.

*Syringothyris texta (Hall) This is a common and characteristic fossil in the Riverside sandstone throughout the region. Found in the lower shale at but one locality—Pixley knob.	.	.	.	x	x
*Terebratula jucunda Hall Falls of the Ohio (Nettleroth).	x	.	.	.	.
Tropidoleptus carinatus Conrad Common. Scott county (Borden), Clark county (Nettleroth), Lexington, Ind., Huber, Ky.	x	.	.	.	.

Mollusca.

LAMELLIBRANCHIATA.

Actinopteria boydi Con. Rare. Falls of the Ohio (Nettleroth), Lancaster, Ind.	x	.	.	.	.
Actinopteria sp. Borden, Ind.	.	.	.	.	x
Anatina leda Hall Rockford (James Hall).	.	.	x	.	.
*Aviculopecten crassicostatus Hall Falls of the Ohio (Nettleroth), (Hall).	x	.	.	.	.
*Aviculopecten intercostalis Winchell Charlestown.	x	.	.	.	.
*Aviculopecten pecteniformis Conrad Falls of the Ohio, Charlestown (Nettleroth).	x	.	.	.	.
Aviculopecten princips Rare. Falls of the Ohio (James Hall), Bear Grass creek, Louisville, Ky.	x			.	.
Aviculopecten fasiculatus Hall Falls of the Ohio (Nettleroth).	x	.	.	.	.
Aviculopecten sp. Low Gap Ridge and Brownstown, Ind.	.		.	.	x

Cardiopsis sp. Scipio and Lexington, Ind.	.	x	.	.	.
Cardiopsis radiata Meek and Worthen (Cardiomorpha radiata) Rockford (Meek and Worthen).	.	.	x	.	.
Clinopistha antiqua Meek Clark county (Nettleroth).	x	.	.	.	.
Clinopistha striata Nettleroth Clark county (Nettleroth).	x	.	.	.	.
Clinopistha subnasuta (H. and W.) Hall Rare. Louisville, Ky. (James Hall), Clark county (Nettleroth), Lancaster, Ind.	x	.	.	.	.
Conocardium cuneum (Con.) Hall The three varieties of this species recognized by Hall occur abundantly in a single stratum at the Falls of the Ohio.	x	.	.	.	.
Conocardium exiguum Miller, 7 Bunker Hill.	x	.	.	.	.
Conocardium ohioense Meek Common. Falls of the Ohio (James Hall).	x	.	.	.	.
Conocardium parvulum Miller, 17 Bunker Hill.	x	.	.	.	.
Conocardium pulchellum Common at Bartel, Ind., and Crab Orchard, Ky.	x	.	.	.	.
Conocardium trigonale Hall, 11 Madison (Meek), Falls of the Ohio (Nettleroth).	x	.	.	.	.
Cypricardia ventricosa Hall Rockford (James Hall).	.	.	x	.	.
Cypricardinia sp. This species is closely related to, if not identical with, the Coal Measure species C. carbonaria. Brownstown, Low Gap Ridge, and Bartel, Ind., Brooks, Riley's, and Crab Orchard, Ky.	.	.	.	.	x

Cypricardinia cataracta Con. Falls of the Ohio (Nettleroth).	x	.	.	.	.
Cypricardinia? cylindrica H. and W. Louisville, Ky. (James Hall), Falls of the Ohio (Nettleroth).	x	.	.	.	.
Cypricardinia indenta (Con.) Hall Falls of the Ohio (James Hall).	x	.	.	.	.
Cypricardinia inflata var. subequivalvis H. and W. Falls of the Ohio (Nettleroth).	x	.	.	.	.
Glyptodesma cancellatum Nettleroth Falls of the Ohio (Nettleroth).	x	.	.	.	.
Glyptodesma erectum Con. Common. Scipio, Lancaster, Ind.	x	.	.	.	.
Glyptodesma occidentale Hall Common. Falls of the Ohio (James Hall), Scipio, Paris Crossing, Lancaster, Charlestown, Ind., Falls of the Ohio.	x	.	.	.	.
Goniophora truncata Hall Falls of the Ohio (Nettleroth).	x	.	.	.	.
Grammysia arcuata (Con.) H. Falls of the Ohio (James Hall).	x	.	.	.	.
Grammysia gibbosa H. and W. Falls of the Ohio (Nettleroth).	x	.	.	.	.
Grammysia rhomboidalis M. and W. Washington county (Gorby).	.	.	.	.	x
Grammysia ventricosta Meek Washington county (Gorby).	.	.	.	.	x
Leiopteria sp. A large species of this genus occurs abundantly in a single layer at Low Gap Ridge.	.	.	.	.	.
Limoptera cancellata Hall Falls of the Ohio (James Hall).	x	.	.	.	.
*Lunulicardium fragile Hall Scott county (James Hall).	.	x	.	.	.

Macrodon sp. A species closely related to M. blairi has been found at Bartel, Brownstown, Pixley knob, and Borden, Ind.	.	.	.	.	x
Macrodon newarkensis? An imperfect specimen is referred to this species from Riley's, Ky.	.	.	.	.	x
Modiomorpha affinis Hall Common. Clark county (James Hall).	x	.	.	.	.
Modiomorpha alta Hall Falls of the Ohio and Charlestown (James Hall).	x	.	.	.	.
Modiomorpha charlestownensis Nettleroth Clark county (Nettleroth).	x	.	.	.	.
Modiomorpha concentrica Hall Rare. Falls of the Ohio and Charlestown (James Hall), Lexington, Ind.	x	.	.	.	.
Modiomorpha mytiloides Con. Clark county (Nettleroth), Falls of the Ohio.	x	.	.	.	.
Modiomorpha recta Hall Clark county (James Hall).	x	.	.	.	.
*Myalina keokuk Worthen Harrison and Washington counties, 8. Abundant in the sandstone at Low Gap Ridge and Borden, Ind.	.	.	.	.	x
Nucula sp. Rare. Bartel, Ind.	.	.	.	.	x
Nucula hians Hall Rockford (James Hall).	.	.	x	.	.
Nucula nov. sp. Crothersville, Ind.	.	.	x	.	.
Nucula lirata Conrad, 11 Shelby county.	x	.	.	.	.

Nucula neda H. and W. Louisville, Ky. (James Hall), Falls of the Ohio (Nettleroth).	x	.	.	.	.
*Nucula niotica H. and W. Common. Falls of the Ohio (James Hall), (Nettleroth), Charlestown.	x	.	.	.	.
Nucula herzeri Nettleroth Falls of the Ohio (Nettleroth).	x	.	.	.	.
Palæoneilo sp. Crothersville, Ind.	.	.	x	.	.
Palæoneilo bedfordensis Meek Rather common at Pixley knob, Ind., and Riley's, Ky.	.	.	.	x	x
Panenka radians Conrad (Cardiola radians?) Scott county (Whitfield).	.	.	.	.	.
*Paracyclas elliptica Hall, 10 Falls of the Ohio and Charlestown, Ind. (James Hall), Lexington and Watson, Ind.	x	.	.	.	.
Paracyclas elongata Nettleroth Clark county (Nettleroth).	x	.	.	.	.
*Paracyclas lirata (Con.) Hall Falls of the Ohio and Clark county (James Hall).	x	.	.	.	.
Paracyclas octerlonii Nettleroth Falls of the Ohio (Nettleroth).	x	.	.	.	.
Paracyclas ohioensis Meek Clark county (Nettleroth).	x	.	.	.	.
*Pterinea flabellum Con Rare. Falls of the Ohio, 11, Lancaster, Ind.	x	.	.	.	.
Pterinea grandis Hall Scott county (James Hall).	x	.	.	.	.
Pterinopecten nodosus Hall Falls of the Ohio (James Hall).	x	.	.	.	.

Pterinopecten reflexus Hall Falls of the Ohio (James Hall).	x	.	.	.	.
Pterinopecten sp. A single specimen from Borden, Ind.	.	.	.	.	x
Ptychodesma knappianum H. W. Falls of the Ohio (James Hall).	x	.	.	.	.
Schizodus chemungensis Rare. Borden, Ind.	.	.	.	.	x
Schizodus contractus Rare. Lancaster, Ind.	x	.	.	.	.
Schizodus medinensis Meek Knobstone, Washington county (Gorby).	.	.	.	.	.
Schizophoria sp. Riley's, Ky.	.	.	.	.	x
Solenomya (Janeia) vetusta Meek Falls of the Ohio (James Hall).	x	.	.	.	.
Spathella typica? A specimen from Borden, Ind., is doubtfully referred to this species.	.	.	.	.	.
Sphenotus flavius Hall One specimen larger than those figured by Hall is provisionally referred to this apecies. Borden, Ind.	.	.	.	.	.
Streblopteria media Pixley knob and Low Gap Ridge, Ind.	.	.	.	.	x
Yoldia? valvulus H. and W. Clark county (Nettleroth).	x	.	.	.	.

Gastropoda.

*Bellerophon crenistria Hall Clark county.	x	.	.	.	.
*Bellerophon cyrtolites Hall Rockford (Hall), (Meek and Worthen).	.	.	x	.	.
*Bellerophon fatulus Hall, 11 Charlestown and Shelby county, Ind.	x	.	.	.	.

Bellerophon galesriculatus Winch.? Common at Bartel, Ind.	.	.	.	.	x
Bellerophon leda Hall Clark county (Nettleroth).	x	.	.	.	.
Bellerophon lineolatus Hall Rockford (James Hall).	.	.	x	.	.
Bellerophon lyra Hall Louisville, Ky. (Hall and Whitfield).	x	.	.	.	.
*Bellerophon pelops Hall Charlestown.	x	.	.	.	.
Bucania devonica H. and W. Rather rare. Clark county (Nettleroth) (Hall and Whitfield), Kent, and Charlestown, Ind.	x	.	.	.	.
Callonema bellatulum Hall Rare. Falls of the Ohio (Nettleroth), Kent, Ind.	x	.	.	.	.
Callomea imitator H. and W. Common. Clark county (Nettleroth), Falls of the Ohio.	x	.	.	.	.
Cyclonema cancellatum? Rare. Lancaster, Ind.	.	.	.	.	.
Cyclonema pulchellum Mill. and G. Knobstone, New Albany (Miller and Gurley).	.	.	.	,	.
*Euomphalus cyclostomus Hall Shelby county, Ind., 11.	x	.	.	.	.
Euomphalus decewi Bill Clark county (Nettleroth), Charlestown, Ind.	x	.	.	.	.
Euomphalus lens Hall. (See Straparollus lens)	.	.	x	.	.
Euomphalus sampsoni Nettleroth Clark county (Nettleroth).	x	.	.	.	.
*Euomphalus tioga Hall Charlestown.	x	.	.	.	.

Holopea grandis M. and G. Knobstone, New Albany (M. and G.	.	.	.	.	.
*Isonema lichas Hall Charlestown.	x	.	.	.	.
Loxonema hamiltonæ Hall Clark county (Nettleroth).	x	.	.	.	.
*Loxonema hydraulicum H. and W. Charlestown (Nettleroth), Kent, Ind.	x	.	.	.	.
Loxonema lævisculum Hall Falls of the Ohio (Nettleroth).	x	.	.	.	.
Loxonema nexile Phillips, 11 Shelby county, Ind.	x	.	.	.	.
Loxonema rectistriatum Hall Falls of the Ohio (Nettleroth).	x	.	.	.	.
*Loxonema teres Hall Falls of the Ohio and Charlestown.	x	.	.	.	.
Loxonema sp Rare. Borden, Ind.	.	.	.	.	x
Loxonema nov. sp Common. Parksville, Ky.	.	.	.	.	.
Macrochilina carinata Nettleroth Rare. Falls of the Ohio (Nettleroth), Lexington, Ind.	x	.	.	.	.
Murchisonia desiderata Hall Falls of the Ohio (Nettleroth).	x	.	.	.	.
Murchisonia indianensis M. and G. Knobstone, New Albany (M. and G.).	.	.	.	.	.
Murchisonia (Pleurotomaria) limitaris Hall Rockford (James Hall).	.	.	x	.	.
Naticopsis sp Rare. Bartel, Ind.	.	.	.	.	x
*Naticopsis gigantea Hall Falls of the Ohio.	x	.	.	.	.
*Naticopsis lævis Meek Charlestown.	x	.	.	.	.

*Platyceras ammon Hall Charlestown.	x	.	.	.	.
Platyceras attenuatum Hall, 6 Madison.	x	.	.	.	.
Platyceras buculentum H Rare. Clark county (Nettleroth), Kent, Ind.	x	.	.	.	.
*Platyceras carinatum Hall Charlestown and Falls of the Ohio, Scipio, Ind., Bear Grass creek, Louisville.	x	.	.	.	.
Platyceras compressum Nettleroth Falls of the Ohio (Nettleroth).	x	.	.	.	.
*Platyceras conicum Hall Falls of the Ohio (Nettleroth).	x	.	.	.	.
Platyceras crassum Hall ? Rare. Kent, Ind.	x	.	.	.	.
*Platyceras cymbium Hall Charlestown.	x	.	.	.	.
*Platyceras dumosum Conrad Clark and Jennings counties (Nettleroth), Falls of the Ohio, Bear Grass creek, Louisville.	x	.	.	.	.
*Platyceras dumosum var. rarispinum Hall Falls of the Ohio.	x	.	.	.	.
*Platyceras echinatum Hall Clark county (Nettleroth), Bear Grass creek, Louisville.	x	.	.	.	.
*Platyceras erectum Hall Charlestown (Nettleroth), Lancaster, Kent, and Lexington, Ind.	x	.	.	.	.
Platyceras (Orthonychia) fluctuosum Ulrich Falls of the Ohio (Ulrich).	x	.	.	.	.
*Platyceras haliotoides M. and W. Rockford.	.	.	x	.	.

Platyceras herzeri Winch.? Rare. Crab Orchard, Ky.	.	.	.	.	x
Platyceras indianense M. and G. Charlestown (M. and G).	x	.	.	.	.
Platyceras infundibulum M. and W., 8. Knobstone, Washington county, Harrison county.	.	.	.	.	.
Platyceras milleri Nettleroth Falls of the Ohio (Nettleroth).	.	.	.	.	.
Platyceras lodense Meek Rare. Parksville, Ky.	.	.	.	.	x
*Platyceras multispinosum Meek Falls of the Ohio (Nettleroth).	x	.	.	.	.
Platyceras quinquesinuatum (Ulrich) Falls of the Ohio (Ulrich).	x	.	.	.	.
Platyceras rictum Hall Clark county (Nettleroth).	x	.	.	.	.
Platyceras serratum Ulrich Falls of the Ohio (Ulrich).	x	.	.	.	.
*Platyceras subundatum Conrad Falls of the Ohio.	x	.	.	.	.
Platyceras symmetricum Hall Clark county (Nettleroth).	x	.	.	.	.
*Platyceras thetis Hall Falls of the Ohio, Charlestown (Nettleroth.	x	.	.	.	.
Platyceras uncum Meek and Worthen, 8 Knobstone, Harrison county.	.	.	.	.	.
*Platyceras ventricosum Conrad Clark county (Nettleroth).	x	.	.	.	.
Platystoma lineatum Hall Rare. Clark county (Nettleroth), Lancaster, Falls of the Ohio, Brooks, Ky.	x	.	.	.	.
Platystoma lineatum var. callosum Hall Clark county (Nettleroth), Kent, Ind.	x	.	.	.	.

Platystoma turbinatum Hall.................. Falls of the Ohio (Nettleroth).	x	.	.	.	.
Platystoma turbinatum var. cochleatum H.. Louisville, Ky. (Nettleroth).	x	.	.	.	.
*Pleuronotus decewi Billings.................. Falls of the Ohio.	x	.	.	.	.
Pleurotomaria sp................................ An unfigured species occurs abundantly in the sandstone at Borden and Low Gap Ridge, Ind.	.	.	.	.	x
Pleurotomaria arabella Nettleroth........... Clark county (Nettleroth).	x	.	.	.	.
*Pleurotomaria imitator Hall................. Charlestown.	x	.	.	.	.
*Pleurotamaria lucina Hall..................... Charlestown and Bartholomew county.	x	.	.	.	.
*Pleurotomaria lucina var. perfasciata Hall Falls of the Ohio, Clark county (Nettleroth).	x	.	.	.	.
Pleurotomaria mitigata Hall.................. Rockford (James Hall).	.	.	x	.	.
Pleurotomaria procteri Nettleroth........... Clark county (Nettleroth).	x	.	.	.	.
*Pleurotomaria sulcomarginata Con......... Rare. Falls of the Ohio (Nettleroth). Lancaster, Ind.	x	.	.	.	.
Pleurotomaria textiligera Meek.............. Knobstone, Washington county (Gorby).	.	.	.	.	.
Pleurotomaria vadosa H........................ Rockford (James Hall).	.	.	x	.	.
Polyphemopsis sp................................ Rare. Pixley Knob, Ind.	.	.	.	x	.
Polyphemopsis louisvillæ H. and W......... Falls of the Ohio (Nettleroth).	x	.	.	.	.
*Straparollus lens Hall......................... Rockford (Hall).	.	.	x		.

Straparollus spirorbis Hall (Euomphalus spirorbis) Rockford (James Hall).	.	.	x	.	.
Strophostylus sp. Rare. Bartel, Ind.	..	.	.	.	x
Strophostylus varians Hall Falls of the Ohio (Nettleroth).	x	.	.	.	.
Trochonema emaceratum Hall Louisville (Hall and Whitfield).	x	.	.	.	.
Trochonema rectilaterum Hall Falls of the Ohio (Nettleroth) (Hall), Charlestown, Ind.	x	.	.	.	.
Trochonema yandellanum Hall and W. Falls of the Ohio (Nettleroth) (Hall).	x	.	.	.	.
Turbo shumardi de Verneuil Rare. Clark county (Nettleroth), Falls of the Ohio.	x	.	.	.	.

Pteropoda.

Coleolus acicula Hall Lexington, Ind.	x	.	.	.	.
*Coleolus tenuicinctus Hall Falls of the Ohio and Charlestown (Hall).	x	.	.	.	.
*Conularia micronema Meek, 8 Clark county.	.	.	.	.	x
*Conularia newberryi Winchell Rare. Harrison county, 8, New Albany, Brownstown, and Low Gap Ridge, Ind.	.	.	.	.	x
Hyolithes aculeatus Hall (Puginculus aculeatus) Rocksord (James Hall).	.	.	x	.	.
Hyolithes nov. sp. Rare. Borden, Ind.	.	.	.	.	x

*Styliola fissurella Hall (Tentaculites fissurella)........ New Albany and Scott county (Whitfield), Falls of the Ohio (Nettleroth).	x	x	.	.	.
Tentaculites scalariformis Hall.............. Common. Clark county (Nettleroth), Scipio, and Lancaster, Ind.	x	.	.	.	.

Cephalopoda.

Brancoceras ixion (Hall)...................... Scott county and Rockford (Hall).	.	.	x	.	.
Cyrtoceras jasoni................................ Rare. Lexington, Ind.	x	.	.	.	.
*Cyrtoceras ohioense Meek.................. Charlestown.	x	.	.	.	.
Gomphoceras minum Beecher................ Falls of the Ohio (James Hall), Lexington, Ind.	x	.	.	.	.
*Gomphoceras oviforme Hall.................. Charlestown (Nettleroth).	x	.	.	.	.
*Gomphoceras raphanum Hall............... Charlestown.	x	.	.	.	.
*Gomphoceras turbiniforme M. and W..... Charlestown (Meek and Worthen) (Nettleroth).	x	.	.	.	.
Goniatites brownensis Miller, 17............. (Knobstone), Brown county (Miller).	.	.	.	.	.
Goniatites greenei Miller...................... Rare. New Albany, 18, and Bartel, Ind.	.	.	.	.	x
Goniatites indianensis Miller, 17............. Knobstone, Clark county (Miller).	.	.	.	.	.
*Goniatites lyoni M. and W......... .... Rockford (Meek and Worthen), Crothersville, Ind.	.	.	x	.	.

Gyroceras gracile (Hall) Rockford (James Hall).	.	.	x	.	.
*Gyroceras inelegans Meek Falls of the Ohio.	x	.	.	.	.
Gyroceras jason Hall Rare. Lexington, Ind.	x	.	.	.	.
Gyroceras? rockfordensis M. and W. Rockford (Meek and Worthen).	.	.	x	.	.
*Munsteroceras oweni (Hall) Common. Scott county, 10, Rockford (Hall), Crothersville, Ind.	.	.	x	.	.
*Munsteroceras parallum (Hall) Rockford (James Hall).	.	.	x	.	.
Nautilus maximus Conrad Falls of the Ohio (Nettleroth).	x	.	.	.	.
*Nautilus (Cryptoceras) rockfordensis M. and W. Rockford (M. and W.).	.	.	x	.	.
Nautilus (Discus) trisulcatus M. and W. Rockford (M. and W).	.	.	x	.	.
Orthoceras sp. Brownstown, Pixley knob, and New Albany, Ind.	.	.	.	.	x
Orthoceras caldwellense M. and G. Clark county (M. and G.).	x	.	.	.	.
*Orthoceras heterocinctum Winch. Rockford.	.	.	x	.	.
Orthoceras icarus Beecher Rare. Rockford (James Hall), Crothersville.	.	.	x	.	.
Orthoceras indianense Hall Common. Rockford (James Hall), Crothersville, Ind.	.	.	x	.	.
Orthoceras marcellense Vanuxem Rockford (James Hall).	.	.	x	.	.

*Orthoceras whitii Winch. Rockford.	.	.	x	.	.
*Phragmoceras walshi M. and W.? Jeffersonville.	x	.	.	.	.
Remeleceras clarkense M. and G. Sampson Springs, Clark county, Ind., (M. and G.).	.	.	.	x	.
Soleniscus rockfordense Miller, 17 Rockford.	.	.	x	.	.
Solenochilus henryvillense M. and G. Knobstone, Henryville, Ind. (M. and G.	.	.	.	.	.
Solenochilus rockfordense Miller Rockford (Miller).	.	.	x	.	.
Trematodiscus digonus M. and W. (Nautilus digonus) Jackson county (Collett).	.	.	.	.	x
Trematodiscus trisulcatus M. and W. (Nautilus trisulcatus) Rockford (M. and W.).	.	.	x		.

Arthropoda.

Class Crustacea.

PALÆOSTRACA.

Calymene platys Greene Falls of the Ohio (Hall and Clark).	x				.
Dalmanites anchiops var. sobrinus H. and C. Falls of the Ohio (H. and C.).	x			.	.
Dalmanites (Coronura) aspectans Conrad Falls of the Ohio (H. and C.).	x	.			.
Dalmanites (Chasmops) calypso Hall Falls of the Ohio (H. and C.).	x			.	
Dalmanites selenurus Rare. Falls of the Ohio.	x	.	.	.	.

*Dalmanites ohioensis M. and W. Madison and Falls of the Ohio.	x	.	.	.	.
Dalmanites (Cryphæus) pleione Hall (Dalmania pleione) Falls of the Ohio and Jennings county (H. and C.).	x	.	.	.	.
*Phacops bufo Green Rare. Charlestown, North Vernon, and Falls of the Ohio (M. and G.)., Watson, Lexington, Lancaster, Ind.	x	.	.	.	.
Phacops rana Green Rare. Brooks, Ky.	x	.	.	.	.
Phacops cristata var. pipa H. and C. Rare. Falls of the Ohio (H. and C.)., Bear Grass creek, Louisville.	x	.	.	.	.
Phillipsia rockfordensis Winch Rockford (Herrick).	.	.	x	.	.
Phæthonides n. sp. A species closely allied to P. spinosus occurs at Bartel, Ind., and Crab Orchard, Ky.	.	.	.	.	x
Piliolites ohioensis Cozzens Falls of the Ohio (Cozzens).	x	.	.	.	.
Proetus auriculatus Hall Rare. Crab Orchard, Ky., and Low Gap Ridge and Bartel, Ind.	.	.	.	.	x
Proetus canaliculatus H. and C. Common. Falls of the Ohio (H. and C.)., Scipio, Ind.	x	.	.	.	.
Proetus clarus Hall Falls of the Ohio (James Hall and J. M. Clarke).	x	.	.	.	.
*Proetus crassimarginatus Hall Common. Falls of the Ohio (Hall), Brooks, Ky., Bear Grass creek, Louisville.	x	.	.	.	.
Proetus doris Hall Rockford, Ind. (Hall) (Herrick.	.	.	x	.	.

*Proetus longicaudus Hall Falls of the Ohio.	x	.	.	.	.
Proetus microgemma H. and C. Rare. Falls of the Ohio (H. and C.).	x	.	.	.	.
*Proetus planimarginatus Meek Madison, Falls of the Ohio.	x	.	.	.	.

Entomostraca.

Aparchites inornatus Ulrich Falls of the Ohio (E. O. Ulrich).	x	.	.	.	.
Barychilina puncto-striata Ulrich Indiana (Ulrich).	x	.	.	.	.
Barychilina puncto-striata var. cutta Ulrlch Falls of the Ohio (Ulrich).	x	.	.	.	.
Barychilina pulchella Ulrich Falls of the Ohio (Ulrich).	x	.	.	.	.
Beyrichia (Depranella?) kalmodini Jones Falls of the Ohio (Ulrich).	x	.	.	.	.
Beyrichia lyoni Ulrich Falls of the Ohio (Ulrich).	x	.	.	.	.
Bollia obesa Ulrich Falls of the Ohio (Ulrich).	x	.	.	.	.
Bollia pumila Ulrich Weisburg, Ind. (Ulrich).	x	.	.	.	.
Bythocypris indianensis Ulrich Falls of the Ohio)A. E. Ulrich).	x	.	.	.	.
Bythocypris punctulata Ulrich Falls of the Ohio (A. E. Ulrich).	x	.	.	.	.
Ctenobolbina (Bollia?) antespinosa Ulrich Falls of the Ohio (Ulrich).	x	.	.	.	.
Ctenobolbina informia Ulrich Falls of the Ohio.	x	.	.	.	.
Ctenobolbina papillosa Ulrich Falls of the Ohio (Ulrich).	x	.	.	.	.

Cytheropsis sp. Little York, Washington county, Ind.	.	.	.	x	.
Halliella retifera Ulrich Falls of the Ohio (Ulrich).	x	.	.	.	.
Isochilina rectangularis Ulrich Falls of the Ohio (Ulrich).	x	.	.	.	.
Kirkbya subquadrata Ulrich Falls of the Ohio (Ulrich).	x	.	.	.	.
Leperditia sp. Crothersville, Ind.	.	.	x	.	.
Leperditia ? subrotunda Ulrich Falls of the Ohio (E. O. Ulrich).	x	.	.	.	.
Octonaria clavigera Ulrich Falls of the Ohio (A. E. Ulrich).	x	.	.	.	.
Octonaria devonica Ulrich Falls of the Ohio (A. E. Ulrich).	x	.	.	.	.
Octonaria ovata Ulrich Falls of the Ohio (E. O. Ulrich).	x	.	.	.	.
Octonaria stigmata Ulrich Falls of the Ohio (E. O. Ulrich).	x	.	.	.	.
Octonaria stigmata var. loculosa Ulrich Falls of the Ohio (E. O. Ulrich).	x	.	.	.	.
Octonaria stigmata var. oblonga Ulrich Falls of the Ohio (E. O. Ulrich).	x	.	.	.	.
Pachydomella tumida Ulrich Falls of the Ohio (A. E. Ulrich).	x	.	.	.	.

Vertebrata.

PISCES.

Gyracanthus compressus Newberry Dearborn county (Newberry).	.	.	.	.	.
Machæracanthus major Newberry Rare. Lexington, Ind.	x	.	.	.	.

Macropetalichthys rapheidolabis Norwood and Owen. (Norwood and Owen).	x	.	.	.	.
Onychodus sigmoides Newberry ? Common. Scipio, North Vernon, Paris Crossing, Lancaster, Ind.	x	.	.	.	.
Orodus multicarinatus N. and W. (Norwood snd Worthen).	.	.	x	.	.

Plantæ.

Dadoxylon newberryi Dawson Marion county, Ky. (Knott).	.	x	.	.	.
Palæophycus lineare Duden New Albany (Duden).	.	x	.	.	.
Palæophycus newalbense Duden New Albany (Duden).	.	x	.	.	.
Parenchymophycus asphalticum Duden New Albany (Duden).	.	x	.	.	.
Sporangites radiatus Duden New Albany (Duden).	.	x	.	.	.

PART IV.

Discussion and Correlation of Faunas.

Eocarboniferous Faunas.

REVIEW OF PREVIOUS CORRELATIONS.

Very diverse conclusions have been reached as to the proper correlation of these faunas in the Mississippi valley by paleontologists. The controversy relative to the age of the beds variously referred to the Waverly, the Marshall group, the Kinderhook, and the Chemung is one of long standing. The history of these discussions has been well presented by Winchell* and more recently by Williams†. It seems unnecessary therefore to review the history of opinion on this question except in so far as it relates directly to the faunas in Indiana and Kentucky.

In 1841 Prof. James Hall made a brief examination of the beds in Indiana between the Black shale and the Carboniferous limestone. He identified the green shales of the Knobstone (New Providence shale) with the Portage of New York. Of the fossils in the sandstones above these shales he says: "I found shells with close analogy, if not absolute identity, with Chemung species."‡ But the discovery of other shells of Carboniferous type

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*Proc. Am. Phil. Soc., vol. 11, pp. 57-83.
†Bull. U. S. Geol. Surv., No. 80, pp. 173-192.
‡Trans. Am. Assoc. Geol. and Nat., 1840-42, p. 280.

led him to modify this statement by saying: "I was led to question the inference as to absolute identity."[*] The beds were classed by Hall as Carboniferous. Prof. Hall explained his application of the term "sub-carboniferous" to the upper sandstone and shales of the Knobs in the following words: "The more friable and micaceous sandstones above containing fossils of true Carboniferous types, I called sub-carboniferous from the fact that up to that time I was not aware that anything below the base of the great Carboniferous limestone had been recognized as belonging to the Carboniferous period."[†]

The correlation of the shaly beds below the sandstone with the Portage and Chemung groups was based solely upon their lithological resemblance to the New York formations. Hall states that he was unable to find fossils within two hundred feet above the Black shales. Fossils have been found in abundance in these beds since Hall's examination of them, and their fauna is now known to present almost as strongly marked Carboniferous affinities as that of the sandstones above.

In an elaborate paper on the parallelism of American and European palæozaic formations, the distinguished geologist de Verneuil expressed the opinion that "in the states of Indiana, Kentucky, and Tennessee the Carboniferous system comprises all of the micaceous sandstone as far as the Black shales, their lower beds including true Carboniferous species such as the *Spirifer striatus*, *Productus punctatus*, etc."[‡]

The beds above the Black shale were divided into three groups by de Verneuil, as follows:[||]

Carboniferous System.	Sandstones, shales, and limestones of the coals. Carboniferous limestone. Fine grained micaceous sandstone.

The discussion of the parallelism of eastern and western formations was resumed by Prof. Hall again in 1850.[§] He seemed still not quite willing to agree with de Verneuil as to the Carboniferous age of all the sandstones and shales above the Black shale, and says: "The green shales and yellow sandstones of Ohio and Indiana which succeed this black shale have been recognized as Carboniferous by their fossils, though there is still some doubt whether the lower part may not represent the Chemung group of New York."*

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[*] Trans. Am. Assoc. Geol. and Nat., vol. 1, p. 28.

[†] " " " " " " " " " "

[‡] Am. Jour. Sci., 2d. ser., vol. 7, p. 46, 1849.

[||] Ib.

[§] Foster and Whitney's Rept. on Geol. L. Sup. Land. Dist., pt. 2, p. 307.

In 1851 Mr. Christy, in a communication to the American Association,† announced that he had found the Rockford limestone to be centrally located in the Black shale, about thirty feet of shale lying above it. This conclusion has since been shown to be eroneous. All who have since studied the stratigraphy of these formations concur in placing the Rockford limestone at the top of the Black shale.

D. D. Owen‡ classed the "Knob formation" of Kentucky as the base of the sub-carboniferous in 1856. In 1860 Meek and Worthen in describing a new *Sphenopterium* from the Rockford limestone stated that the specimen is "from beds probably of Upper Devonian age, but containing Carboniferous *Goniatites.*"||

In 1860 Sidney Lyon§ published a section of the rocks of Kentucky, in which he classed with the "Sub-carboniferous Series" the "Knobstone Beds," as well as the beds below them, down to and including the *Catinopora* beds of the Niagara.

In a paper published by Prof. Hall¶ in 1861 he attempts to prove the parallelism of the Rockford limestone and the band of limestome occurring in the midst of the Marcellus shale. In this paper the Rockford *Goniatites* are considered of Hamilton age and the Knob sandstone and shales "are recognized as of the age of the Chemung group of New York."

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*Foster and Whitney's Rept. on Geol. L. Sup. Land. Dist., pt. 2, p. 307.

†Proc. Am. Assoc., vol. 5, p. 76.

‡Ky. Geol. Rept., vol. 1, p. 89.

||Description of New Carboniferous Fossils from Illinois and Other Western States, Proc. Phil. Acad. Nat. Sci., Sept. 1860, p. 447.

§Trans. St. Louis Acad. Sci., 1, pp. 614-619.

¶13th Rept. N. Y. Regents, p. 95.

In 1861 Meek and Worthen[*] published a paper on the age of the Goniatite limestone at Rockford, Ind. The erroneous assertion of Christy that the Rockford limestone is central in the Black shale is corrected by these authors, who state that the Black shale lies entirely below the limestone. The Rockford limestone is identified by them to be of the same age as the Chouteau limestone of Missouri. This determination is based upon the identification of at least six of the twenty-three or twenty-four known Rockford species with characteristic Chouteau species. These species are *Nautilus digonus* M. and W., *Euomphalus lens* Hall, *Rhychonella missouriensis* Shumard, *Spirifer cooperensis* Swall., *Cardiopsis radiata* M. and W., and *Sphenopterium enorme* M. and W.

It seems to the writer that in correlating the Rockford limestone with other formations in the Mississippi valley considerable weight should be given to the stratigraphic evidence, since it lies directly above the Black shale, a formation which may be readily recognized throughout most of the Paleozoic area of the Mississippi valley. Should the stratigraphic evidence be given principal weight, the Rockford limestone would be correlated not with the Chouteau, but with the Lithographic limestone. Both the Rockford and the Lithographic limestones lie immediately above the Black shale. Both are rather local in their extent. The lithological description given by Worthen of the Lithographic limestone is in part as follows: "It is usually of a light bluish-green or dove color, weathering to a drab. It breaks with a smooth conchoidal fracture."[†] It would be difficult to give a better physical description of the Rockford limestone of Southern Indiana than this. The Lithographic limestone is stated by these authors to be "rather local,"[‡] which is also a characteristic of the Rockford limestone.

The following section[||] is given of the Missouri beds:

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[*] Am. Jour. Sci., 2d ser., vol. 32, p. 167.

[†] Geol. Surv. of Ill., vol. 1, p. 114.

[‡] Am. Jour. Sci., vol. 32, 2d ser., p. 170.

[||] Ib.

		Feet.
1.	Burlington limestone	200
2.	Chouteau	100
3.	Vermicular sandstone and shale	65–100
4.	Lithographic limestone (rather local)	60
5.	Black shale	30–40
6.	Hamilton group	120

In southern Indiana we have the following section (generalized):

	Feet.
Carboniferous limestones	300–400
Massive to shelly sandstone	150–300
Argillaceous blue to green shales	50–200
Black shale	100–120
Hamilton	

The relative position of the Rockford limestone and the Lithographic limestone in these two sections affords very strong stratigraphic evidence of their equivalence. According to Meek and Worthen not one of the fossils occurring in the Lithographic limestone can be positively identified with Hamilton species with the possible exception of an *Orthis*, while many of the fossils in it occur in the Chouteau beds. The fossils therefore present no evidence against correlating the Lithographic and the Rockford beds. On the other hand, if the Rockford limestone is the equivalent of the Chouteau it seems remarkable that *Syringothyris carteri*, which is a common species in the Chouteau, should be represented by the closely related species *S. texta* in the Knobstone of the Indiana section, while the genus is entirely unknown in the Rockford limestone.

In the face of evidence now at hand it seems to us that the Rockford limestone must be considered the equivalent of the Lithographic or Louisiana limestone of the later Missouri reports.

In a foot note* to this paper the authors propose the name "Kinderhook group," to include the beds lying between the Black slate and the Burlington limestone.

During the year 1862 Prof. Hall was led to change his opinion regarding the Marcellus age of the Rockford *Goniatites* by finding the Rockford species *G. hyas* among fossils from the Waverly of Ohio. This led him to "conclude that the position assigned to the *Goniatites* beds of Rockford may be erroneous and that the true position is higher in the series or more nearly in a parallel with the Chemung group."†

In 1862 Messrs. White and Whitfield published a paper entitled "Observations upon the Rocks of the Mississippi Valley Which Have Been Referred to the Chemung Group of New York, Together with Descriptions of New Species of Fossils from the Same Horizon at Burlington, Iowa."‡ The authors state that sufficient fossils have not been found to determine the age of the lower Knob shales in Indiana and Kentucky. The fossils of the upper sandstones they consider to be more nearly related to those of the Keokuk than to those of the Burlington limestone or the Chemung rocks of the Mississippi valley. "Barely enough of the fossils of the Burlington limestone are recognized there to show that it is represented."||

During the same year Prof. A. Winchell published two papers on the Marshall and Huron groups of Michigan. In one of these§ five species from the Marshall group are identified with fossils previously described from Rockford, Ind.

In 1862 Prof. Robert Owen¶ designated the sandstones and

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*Am. Jour. Sci., 2d ser., vol. 32, 1861, p. 288.

†15th Rept. N. Y. Regents, p. 81.

‡Proc. Bost. Soc. Nat. Hist., vol. 8, p. 289.

||Ib., p. 292.

§Proc. Acad. Nat. Sci. Phil., 1862, p. 405.

¶Ind. Geol. Rept., 1862, pp. 92, 108, etc.

shales below the Carboniferous limestone as "sub-carboniferous," after D. D. Owen.

In 1863 Prof. A. Winchell* endeavored to show by a synopsis of the paleontological evidence that the Chemung, Waverly, Marshall, Rockford, and Burlington beds were synchronous and should be classed within the Carboniferous system.

In 1865 Prof. Winchell presented another paper on these rocks. He had compared a large number of species from western rocks supposed to be of Chemung age with the types of the New York Chemung and failed to identify a single species with Chemung types. Some of the Waverly species, however, were found to be identical with fossils from the conglomerate in western New York which had been identified with the Carboniferous of Pennsylvania. This led Winchell to abandon his former opinion of the Carboniferous age of the Chemung and its correlation with the Waverly, Marshall, and Rockford beds of the west, and to incline to the view that the conglomerate of western New York is "the attenuated and littoral prolongation of those western sandstones and shales."

During the year 1866 the first volume of the Illinois Survey† was published, in which Mr. Worthen describes at some length the Kinderhook group. This group, he states, includes the Chouteau limestone, the Lithographic limestone, and the Vermicular sandstone and shales of the Missouri Report, the so-called Chemung of Iowa, the Waverly of Ohio, and the Goniatite limestone of Rockford, Ind. The following section is given at Hamburg, Calhoun county, Illinois:

	Feet.
Green arenaceous and argillaceous shales.......	60–70
Shelly oolitic limestone............................	8–10
Compact fine-grained limestone....................	15–20

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*Am. Jour. Sci., 2d ser., vol. 35, p. 61.

†P. 109.

Worthen identified the Knobstone of southern Indiana, the argillaceous shales at Crawfordsville, and about "thirty feet of greenish-colored shale and shaly sandstone" and thin band of limestone lying below the conglomerate near Williamsport, Ind., with the Keokuk. The sandstones below the limestone band at Williamsport he refers to the Kinderhook on lithological grounds, no fossils being reported from it. The determination of the Keokuk age of the formations mentioned above is based by Worthen upon the presence in them of *Spirifer cuspidatus*, *Hemipronites crenistria*, *P. semireticulatus*, *Orthis michelini*, *P. punctatus*, and *Spirifer lineatus*.

The equivalency of this fauna with the Keokuk fauna can hardly be proven by the evidence of the species cited, since not one of them is distinctly characteristic of the Keokuk fauna. *Productus punctatus* and *P. semireticulatus* are known to range throughout the Carboniferous. *Spirifer lineatus* (*Reticularia perplexa*) is regarded as an Upper Carboniferous species and if present would tend to indicate a higher horizon for the Knobstone than the Keokuk. It is very probable, however, that Worthen mistook *Reticularia pseudolineata* (Hall), which is common to the Burlington and Keokuk, for *Spirifer lineatus*. *Spirifer cuspidatus* (*Syringothyris carteri*) has been reported from both Waverly and Burlington faunas, but not from the Keokuk. *Hemipronites crenistria* (Phillips?) is common to the Lower Carboniferous. *Orthis michelini* (*Rhipidomella michelini*) is recorded from the Waverly, but apparently has never been reported from the Keokuk limestone. From this review of Worthen's evidence of the Keokuk age of the sandstones and shales below the Carboniferous it appears that it points rather to a Burlington or Waverly age for them than to parallelism with the Keokuk.

In 1869 Prof. A. Winchell published a paper* reviewing the history of the various attempts to correlate the Lower Carboniferous formations of the Mississippi valley and summing up the stratigraphical knowledge relative to them. The Knobstone series in Indiana is referred to the Keokuk group. The Rockford limestone is said to be represented in northern Indiana by a thin bedded sandstone. It is not quite clear just what sandstone was referred to in this correlation, but it was probably the Riverside.

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*Proc. Am. Phil. Soc., vol. 11, pp. 57-82.

In 1870 Prof. Winchell published a paper on the "Geological Age and Equivalents of the Marshall Group."* A catalogue of the fossils of the Marshall group and its supposed equivalents in the United States is given. From this catalogue it appears that there are nine species common to the Rockford limestone and the Marshall group. The Rockford limestone and a sandstone in northern Indiana, which in the table of geological equivalents is called the Williamsport sandstone, are correlated with the Marshall group. The exact stratigraphic position of the Williamsport sandstone is not shown and no satisfactory reasons are given for considering it the equivalent of the Rockford limestone. The presence in the Marshall group of such a characteristic Rockford species as *Goniatites oweni* affords strong evidence that the Rockford limestone is the equivalent of some part of the Marshall group, but that the three hundred feet† of sandstones and shales constituting Winchell's Marshall group in Michigan should be represented by only three or four feet of limestone in southern Indiana is not probable.

The Report of the State Geologist of Indiana for 1873 contains the following section of the rocks in the southern part of the state by W. W. Borden‡:

		Feet.
Soil and clay		20 – 40
Knob limestone—Keokuk group		80
Knob sandstone. Knob shale.	Kinderhook group	344
New Albany Black slate. Crinoidal limestone. Hydraulic limestone.	Hamilton group	140

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*Proc. Am. Phil. Soc., 12, pp. 385-418.
†Proc. Am. Phil. Soc., vol. 11, p. 74.
‡P. 172.

	Feet.
Corniferous limestone.—Upper Helderberg group	22
Utica limestone.—Niagara group	30
Madison limestone.—Cincinnati group	207
Magnesian limestone.—Clinton group	30

It will be noted that the Rockford limestone, from which the typical Kinderhook fauna was described, is entirely omitted from the above section.

No important additions have been made to the literature relative to the geological equivalents of the Rockford limestone and the shales and sandstones above them in Indiana since the appearance of Winchell's paper in 1870. A number of new fossils have been described from the sandstones and shales of the Knobs by Hall and Clark and Miller and Gurley. In referring a new species to the Knobstones group Miller and Gurley explain that it "means the Keokuk group and the Waverly, where the two are not separable and the fossils are generally casts."*

Hall and Clark†, in referring to the age of the "Knobstone group," state that "the lowest member has generally been regarded as of the age of the Waverly and the upper member equivalent to the Keokuk."

Quite recently Mr. Miller‡ has attempted to prove by stratigraphic evidence that the Waverly of Ohio and eastern Kentucky formerly extended across the Silurian area and were continuous with the Knobstone and superior formations in Indiana and Kentucky west of the Cincinnati geanticline.

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*Bull. Ill. Surv., No. 12, p. 50.

†Pal. N. Y., vol. 8, pt. 1, p. 225.

‡Am. Geol., August '98. vol

RELATIONS OF THE FAUNAS.

ROCKFORD LIMESTONE FAUNA.

The fauna of the Rockford limestone is quite unlike either the fauna above or below it in the Indiana sections, although its affinities are distinctly Carboniferous. A study of the species recorded from the Rockford fauna in Part III shows that seventeen species, or more than one third of the total number reported in it, belong to the *Cephalopoda*. Nearly all of the species of this fauna have been described from Rockford, and very few of these have been reported from other horizons or localities.

The only species of *Protozoa* recorded from this fauna is also reported by Keyes from the Kinderhook of Missouri.

Of the two corals only one is known elsewhere, and this one is reported doubtfully from just above the Black shale in Tennessee and the Waverly in Ohio.

Of the four Brachiopods which have been positively identified in this fauna one is known from the Kinderhook and one from the Waverly outside of the state, while the other two are unknown outside of the Rockford limestone. Not one of these four has been identified in the faunas above or below the Rockford limestone. The presence in the fauna of a *Leiorhynchus*, which is probably *L. quadicostatus* and *Ambocœlia gregaria*, affords the only trace of Devonian affinities observed in the fauna.

Nine Gastropods have been recorded from the Rockford limestone, none of which are known in the other faunas of the Indiana and Kentucky sections.

The Cephalopods are represented by seventeen species, all of which, so far as known, are limited in Indiana and Kentucky to this fauna.

Only two species of Trilobites have been described from the Rockford fauna, one of which, *Proetus doris*, has been identified by Herrick in the Ohio Waverly.

The unique character of the Rockford limestone fauna, furnishing as it does so many species not known in other faunas, seems to fully justify its separation from the faunas above and its recognition as the sole representative of the Kinderhook fauna in Indiana.

The Rockford fauna, which has heretofore been known only at Rockford, has been found in Jennings county and in the southern part of Scott county some thirty miles south of the original locality. The three or four feet of limestone to which it is confined contains at most localities very few or no fossils. The Rockford limestone, which is a persistent formation in southern Indiana, has not been seen south of the Ohio, and no trace of its fauna has been found in Kentucky. The Rockford limestone evidently disappears by thinning toward the south and is represented in the Kentucky sections by the greenish blue argillaceous New Providence shale. These argillaceous shales have been found at one point thirty miles south of Louisville to be separated from the Black shale by a few feet of shelly limestone. This limestone, which holds the same stratigraphic position as the Rockford limestone, was found to contain a fauna typical of the New Providence shale, no trace of the Rockford fauna appearing in it. The three species which were found abundantly here are *Rhipidomella oweni*, *Spirifer mortonanus*, and *Spirifer suborbicularis*. These fossils are found at nearly every locality where fossils occur in the New Providence shale, while they have never been found in the Rockford fauna. We have therefore conclusive evidence that the Rockford fauna and the New Providence fauna were contemporaneous and existed side by side over a portion of this area at the end of the Black shale epoch. Much more detailed information concerning the faunas succeeding the Black shale throughout the Mississippi valley is needed before a final and satisfactory correlation of the Rockford fauna in other states can be made. The field work of the writer has shown that the fauna is absent from the Kentucky sections and that the lower part of the New Providence shale is the stratigraphical equivalent of the Rockford limestones in Kentucky. From the local character of the fauna in this area we may fairly expect to find it absent and its interval represented by another fauna in some of the other states of the Mississippi valley. The writer cannot agree with Meek and Worthen's correlation of the Rockford limestone with the Chouteau limestone for reasons stated in reviewing that correlation. The evidence there cited seems to indicate the parallelism of the Louisiana limestone of Missouri with the Rockford limestone.

The presence of *Goniatites oweni*, together with nine other Rockford fossils, in the Marshall group of Michigan, which Winchell* has reported, indicates that the Rockford is represented in Winchell's Marshall group and that the Rockford limestone is the stratigraphic equivalent of some part of the Marshall group, but certainly not of all of it.†

The tables showing the range of the faunas in the Indiana and Kentucky sections indicate clearly that the fauna of the Rockford limestone is the earliest of the Carboniferous faunas in these sections. It may be designated faunally after the name of one of its most characteristic species as the *Munsteroceras oweni* zone of the Eocarboniferous.

RIVERSIDE SANDSTONE AND NEW PROVIDENCE SHALE FAUNAS.

The relation between the faunas of these two formations has been found to be of the closest kind. Neither of the formations is generally fossiliferous. In the lower especially fossiliferous localities are scarce, but when found the fossils are apt to be abundant. In both formations the faunas seem to have lived in colonies covering quite limited areas, with considerable stretches of uninhabited or at least very sparsely populated sea bottom between.

The sandstone in northern Indiana designated as the Riverside sandstone by Mr. Hopkins‡ has been correlated with the upper sandstone and sandshale of the Knob region in southern Indiana on the evidence of fossils collected at and near the typical locality. The following species were obtained:

Lingulodiscina newberryi, *Rhipidomella* sp., *Spirifer* sp., *Spirifer keokuk*, *Spirifer striatiformis*, *Spirophyton crassum*, *Syringothyris texta*, worm trails.

This is a characteristic fauna of the upper "Knobstone" of southern Indiana. *Syringothyris texta* and *Spirifer keokuk* are found at nearly all fossiliferous localities in these beds. *Spirifer keokuk* has never been found by the writer in the New Providence shale and *Syringothyris texta* is known to occur in those beds at only one locality.

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*Pr. Am. Phil. Soc., vol. 12, p. 396.

† " " " " " " " 397.

‡20th Ann. Rept. Ind. Dept. Geol., p. 287.

Brachiopods are more abundant than any other class of fossils in both faunas. Of those which have been positively identified ten are common to the faunas of the Riverside sandstone and the New Providence shale, while twelve species are recorded from the upper fauna which have not been seen in the lower fauna. *Rhipidomella oweni* is perhaps the most abundant and characteristic species of the New Providence shale, and the fauna associated with it may be designated as the *Rhipidomella oweni* zone of the Eocarboniferous.

Applying the same method of nomenclature to the fauna of the Riverside formations it may be called the *Reticularia pseudolineata* zone of the Eocarboniferous.

The distinctly Carboniferous character of these two zones is shown in the extreme scarcity of species which occur in the Devonian and the abundance of Carboniferous types. *Productus punctatus* and *P. semireticulatus* which have been found in these faunas are common Coal Measure species. *Eumetria marcyi*, which has been found in the *Reticularia pseudolineata* zone, is a common species in the St. Louis and the Kaskaskia limestones.

In correlating these faunas with those of the Mississippi series elsewhere it is probably not desirable or practicable to consider them separately. The Brachiopods are probably more reliable for this purpose than other groups, since recent studies have cleared up much of the synonomy involved. An examination of the Brachiopods listed in Part III, with reference to their recorded range elsewhere, shows the following facts: Eight are reported in the Burlington fauna, twenty-two in the Waverly, fifteen in the Keokuk, five in the Kinderhook, two in the Marshall, three in the Coal Measures, one in the St. Louis limestones and one in the Kaskaskia. The very close relationship discovered between the faunas of the Burlington and Keokuk limestones at the typical localities lad to uniting the two under the name of Osage by Williams. Keyes has since used the name Augusta for nearly the same beds as those included in the Osage. The figures shown in the above summary seem to point conclusively to the equivalence of the faunas of the Riverside sandstone and the New Providence shale to the Osage or Augusta group, the number of Brachipods common to the Indiana faunas and Osage group being twenty-three. Nearly the same number of species is common to the Waverly of Ohio and the Indiana faunas, and we may regard the Waverly fauna the equivalent in Ohio of the Riverside and New Providence shale faunas in Indiana. The small number of species common to these faunas and the Marshall of Michigan is probably due to the fact that very few of the Marshall species have been figured, which makes their identification in the Indiana faunas difficult and uncertain.

DEVONIAN FAUNAS.

REVIEW OF PREVIOUS CORRELATIONS.

The earliest attempts to classify the Devonian rocks of Indiana and Kentucky date back to the period when Wernerian ideas were dominant in Geology.

In 1819 W. B. Stilson,* following the example of McClure in applying the Wernerian system to American rocks, referred all of the horizontal strata of Indiana to the "Secondary formation."

In the following year Thomas Nuttall† attempted to classify the horizontal strata of Indiana and other states of the Mississippi valley, and referred them to the "Secondary formation."

As pointed out by Williams,‡ Lardner Vanuxem was one of the earliest, if not the first, in America to show the fallacy of the Wernerian system and to use fossils for purposes of correlation. In an article published in 1829 Vanuxem states his belief in the primary importance of the use of fossils in correlating rocks, in the following words: "The analogy or identity of rocks I determine by their fossils in the first instance and their position and mineralogical characters in the second or last instance."|| Other geologists were not slow to see the importance of this idea, and in

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*Sketch of the Geology and Mineralogy of a Part of the State of Indiana.—Am. Jour. Sci., vol. 1, 1819, pp. 131-133.

†Jour. Acad. Nat. Sci. Phila., vol. 2, 1821, p. 44.

‡Bull. U. S. G. S., vol. 80, p. 32.

||Am. Jour. Sci., vol. 16, 1829, p. 255.

most of the attempts to correlate the Indiana rocks with those elsewhere fossils have played an important part since that date.

In 1837 and 1838 D. D. Owen made a geological survey of Indiana.* In Owen's Report† published in 1839 all of the rocks in Indiana below the coal beds were referred to what Owen called the Sub-carboniferous group. This term was intended to indicate their position "immediately beneath the Coal or Carboniferous group of Indiana." Owen's Sub-carboniferous group was divided as follows:‡

Sub-carboniferous Group.

1. Oolitic limestones.
2. Silicio-calcareous series, with occasional beds of clay.
3. Black bituminous aluminous slate.
4. Fossiliferous and inferior strata of the Sub-carboniferous group, consisting of (1) Fossiliferous beds of the Ohio Falls; (2) Waterlime and variegated strata; (3) Sand or burrstone; (4) Bluish or brownish limestone.

The Devonian series in Indiana and Kentucky is represented in the above classification by number three and the first division of number four.

Owen correlated the Black shale at the base of the knobs in Indiana with a shale in Ohio at "the base of the hills capped with sandstone, bordering the Scioto valley."

In the first Report of the Kentucky Survey|| Owen modified the use of the term Sub-carboniferous so that it included only the rocks between the Coal Measures and the Black Lingula shales. In this report Owen divides the beds below the "Sub-carboniferous limestone and fine-grained sandstones" as follows:§

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*Am. Jour. Sci., vol. 34, 1838, pp. 193-196.

†Report of a Geological Reconnoissance of the State of Indiana.

‡Ibid, pp. 13-19.

||Rept. Ky. Geol. Surv., vol. 1, pp. 16, 17.

§Ibid, p. 16.

Black Lingula shales.

Grey Coralline Falls limestones.

Chain coral and Upper Magnesian Cliff limestone.

Blue, Shell, and Birdseye limestones of Fayette and Franklin counties.

In a report published in 1840* Owen made the following five divisions of the rocks in the states of Indiana, Ohio, Kentucky, and Tennessee:†

Pentremetal limestone, light-colored limestone, sometimes Oolitic.

Fine-grained sandstone in knobs.

Black bituminous shale.

Thick beds of yellow limestone, Cliff limestone of the west.

Blue fossiliferous shell limestone in thin beds with Marlite.

It will be noted that in the above classification the Devonian limestones are not separated from the Niagara, but included with the latter under the name of Cliff limestone of the West.

In the revised edition of Owen's Report published in 1844 the "Black slate" of Ohio and Indiana is considered the equivalent of the Marcellus shale of New York.‡

In 1841 Dr. A. Clapp, in a communication to the Philadelphia Academy of Science,|| correlated the limestone at the Falls of the Ohio with the Wenlock of Murchison by means of the fossils. The Black shale he considered to be the probable equivalent of the Marcellus shale of New York.

In a later communication§ the "Water lime of the Falls of the Ohio," which is described as a drab-colored rock lying below the

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*Mineral Lands of the United States. Message from the president of the Jr. S. in reply to a resolution of the House of Representatives, Feb. 6, 1840. House of Representatives, Executive Document No. 239, Twenty-sixth Congress, first session.

†Ibid., diagram 4, p. 182.

‡Williams, Bull. U. S. G. S., 80, p. 140.

||Proc. Phila. Acad. Sci., vol. 1, 1841, pp. 18, 19.

§ " " " " " " " p. 178.

Black shale and separated from it by a few feet of fœtid limestone, is correlated with the middle or upper part of the Helderberg group.

In 1842 Prof. James Hall read a paper on the "Identity of Western Formations with Those of New York" before the Association of Geologists and Naturalists. In this he stated:* "In the Cliff limestone we have the Helderberg series of New York, or at least two persistent numbers, the Onondoga and Corniferous, with the Water lime and perhaps a meagre representation of the Salt group, together with the Niagara limestone."

Of the Black shale Hall says that "it seems to be the equivalent of the Marcellus of New York and is the only representative of that rock the Hamilton group and the Genesee slate."†

Prof. H. D. Rogers,‡ in discussing Hall's opinion of the age of the Black slate, stated that he could find no trace of the Hamilton group in the west and regarded the Black shale as the equivalent of the Marcellus shale alone.

In a paper before the Association of Geologists and Naturalists in 1843 D. D. Owen expressed the opinion that the Black shale of Indiana and Kentucky was the equivalent of the Marcellus.||

It is to Edward de Verneuil that we are indebted for a correlation of the Paleozoic formations of Indiana and Kentucky which has been very slightly modified by subsequent investigations. M. de Verneuil's views on the parallelism of American and European formations were published in 1847.§ The classification of the Paleozoic rocks of Ohio, Kentucky, and Indiana proposed by de Verneuil is as follows:¶

Carboniferous System.	8. Sandstones, shales, and limestones of the Coal.
	7. Carboniferous limestone.
	6. Fine-grained micaceous sandstone.

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*Trans. Am. Assoc. Geol. and Nat., p. 279.

†Ibid, p. 280.

‡Am. Jour. Sci., vol. 45, 1843, p. 161.

|| " " " " " " " 152.

§Soc. Geol. France, Bull., 2d ser., vol. 4, 1847, pp. 646-709.

¶Am. Jour. Sci., vol. 5, 2d ser. 1848, p. 183.

Devonian system.	5. Black bituminous schists. 4. Shelly limestone and coralline limestone.
Silurian System. (Superior.)	3. Silicious or magnesian limestone (Cliff limestone).
Silurian System. (Inferior.)	2. Blue limestones and marl. 1. Compact limestone.

Regarding the correlation of the Devonian of Indiana and Kentucky with the New York Devonian, de Vernueil states that "in the states of Ohio, Indiana and Kentucky it is reduced to the black shists which represent the Genesee slate and to a calcareous band which represents at once the Corniferous and Onondaga limestone and the Hamilton group of the state of New York."*

In 1851 Prof. Hall published a paper on the "Parallelism of the Palæozoic Deposits of the United States and Europe." Hall seems inclined in this paper to accept de Verneuil's view of the age of the Black shale of the west and says "it may be a representation of the Genesee slate of New York, but holds the place of the Marcellus shale, resting directly upon the Corniferous limestone."† It is apparent from this quotation that Prof. Hall did not recognize any representative of the Hamilton in Indiana and Kentucky at the time it was written. This view he continued to hold for some time. Eleven years later, in speaking of the age of the Goniatite beds at Rockford, Ind., he says: "As the Hamilton group has not been recognized in the south part of Ohio or Indiana, so far as I know, there may yet be room for doubt as to whether this group thins out beneath the Black shale or above it; or, in other words, whether the Black shale of southern Ohio and Indiana, and of Kentucky and Tennessee, may be the continuation of the Marcellus shale or the Genesee slate."‡

Sidney Lyon and S. A. Casseday seem to have recognized the Hamilton at the Falls of the Ohio as early as 1859; for in referring a crinoid described by them to its geological horizon they state that it is found "in the Devonian rocks of the age of the Hamilton group."[*]

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*Am. Jour. Sci., vol. 5, 2d ser., 1848, p. 370.

†Report on the Geology of the Lake Superior Land District, 1851, p. 307.

‡15 N. Y. Regents' Report, 1862, p. 81.

In a paper published by Sidney Lyon[†] in 1860 he gives the following classification of the Sub-carboniferous series:

Sub-carboniferous Series.	n. Cavernous limestone.
	o. Middle limestone.
	p. Sandstones and shales.
	q. Black slate.
	r. Encrinital limestone.
	s. Hydraulic limestone.
	t. Spirifer bed.
	u. Nucleocrinus bed.
	v. Turbo bed.
	w. Coral beds.
	x. Catenipora beds.

Lyon attempts no correlation in this paper of the beds below the Black shale, but is inclined on the evidence of the Rockford Goniatites to place it higher than the Devonian.

In 1860 Hall[‡] had expressed the opinion that the Black shale in Indiana was the "continuation of the Marcellus shale," and that the Rockford limestone was of the same age.

Meek and Worthen[||] pointed out the error of this correlation of the Rockford limestone during the next year and affirmed the Genesee age of the Black shale.

The Report of the State Geologist of Indiana for 1873[§] contains the following classification of the Devonian in Clark and Floyd counties:

New Albany Black slate.	Hamilton group	140
Crinoidal limestone.		
Hydraulic limestone.		
Corniferous limestone.—Upper Helderberg group		22

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[*] Am. Jour. Sci., 2d ser., vol. 28, 1859, p. 244.
[†] Trans. St. L. Acad. Sci., vol. 1, 1859-60, pp. 612-622.
[‡] 10th N. Y. Regents' Report, 1860, p. 96.
[||] Am. Jr. Sci., 2d ser., vol. 32, pp. 167-177.
[§] P. 172.

The Indiana Geological Report for 1874 contains a report on a collection of Black shale fossils which were submitted to Mr. R. P. Whitfield. The study of these led Whitfield* to the conclusion that the Black shales of Indiana "are in part at least equivalent to those known as the Genesee slates of New York," and "that they represent an equivalent in time to that of the entire Hamilton epoch as represented in New York, and perhaps even some of the overlying beds."

In 1877 Prof. Shaler† stated that he considered the Black shale in Kentucky to represent the whole of the Devonian down to the top of the Oriskany. This conclusion is based upon the apparent conformity of the Black shale with supposed Oriskany sandstone in Central Kentucky.

Previous to 1879 Prof. Hall had considered the Devonian limestone in southern Indiana to represent only the Upper Helderberg group. The Hamilton, if present at all, he considered to be represented by some part of the Black shale. In the Report on the Paleontology of New York‡ published in 1879 he published a very instructive tabulation of the Hamilton species which he had recognized in the "Hydraulic beds and associated limestones at the Falls of the Ohio." He concludes from the evidence presented that the "Hydraulic and Encrinital limestones" at the Falls of the Ohio are the equivalent of the Hamilton. In the same paper Hall reviews the question of the age of the Black shale in Indiana and states that "the Black shale of the west is equivalent and even the absolute continuation of the Black shales succeeding the Hamilton group of New York (the Genesee slate)."||

In 1884 John Collett, State Geologist of Indiana, published a geological map§ and section of the State in which the Hamilton is not recognized. The following classification of the formations between the Coal Measures and the Upper Silurian is given:

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*6th Ann. Rept. Ind. Geol. Surv., pp. 181, 182.

†Ky. Geol. Surv., n. 3, vol. 3, pp. 173, 174.

‡Pal. N. Y., vol. 5, pt. 2, pp. 139-154.

||Ibid, p. 152.

§13th Rept. Ind. Dept. Geol. and Nat. Hist.

Lower Carboniferous.	Chester group. St. Louis group. Keokuk group. Knobstone group.
Devonian.	Black slate, or "Genesee shale." Corniferous.

Maurice Thompson in his first report gives the same classification of the Devonian as Collett and states that "the Corniferous rocks and the Genesee shale are the two numbers of the Devonian found in Indiana."[*]

In 1897 Prof. H. S. Williams published a paper "On the Southern Devonian Formations."[†] No direct reference is made to the region under consideration in this paper, but the idea is presented that the upper and lower limits of the "Black shale" formation may vary with reference to the time scale in different regions, and that the formation contains locally, at least, Eocarboniferous faunas.

The Report of the Indiana State Geologist for 1897 contains a paper on the "Geological Scale of Indiana" by Blatchley and Ashley. The authors recognize three divisions of the Devonian in Indiana—the New Albany or Genesee shale, the Hamilton, and the Corniferous. The Hamilton is recognized in the northern part of the state on the authority of Dr. Phinney, but the authors state that "the formation has not been recognized in southern Indiana."[‡] No evidence is offered in connection with this statement to show that Hall's[||] determination of the Hamilton in southern Indiana is incorrect.

CORRELATION OF FAUNAS.

It has been shown in another part of this paper that the New Albany shale and the beds below it are unconformable south of Louisville. As a result of this unconformity the Devonian limestone is pretty generally wanting or very thin in Kentucky. The Sellersburg beds and their fauna have not been seen at all south of Louisville.

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[*] 15th Rept. Ind. Dept. Geol. and Nat. Hist., 1886, p. 11.

[†] Am. Jr. Sci., vol. 3, 1897, pp. 393-403.

[‡] 22d Ann. Rept. Ind. Dept. Geol. and Nat. Res.

[||] Pal. N. Y., vol. 5, pt. 2, pp. 139-154.

The preceding review of the history of the attempt to correlate the Devonian of Indiana and Kentucky with the New York Devonian has shown that the difficulties encountered were chiefly in connection with determining the equivalents of the faunas above the Corniferous. The Corniferous fauna of New York suffers no very important modifications in its western extension. The large number of species common to the fanuas of the Corniferous limestone of New York and the Jeffersonville limestone, especially among the corals, leaves no doubt as to the equivalence of the two faunas. One of the most abundant and characteristic species of this fauna in Indiana and Kentucky is *Spirifer acuminatus*. It is proposed to designate this fauna as the *Spirifer acuminatus* zone of the Eodevonian.

In southern Indiana we find in the Sellersburg beds a fauna containing many of the most characteristic species of the Hamilton of New York. Among the characteristic New York Hamilton Brachiopods which occur in these beds and which are unknown in the Corniferous may be mentioned *Spirifer granulosus*, *Tropidoleptus carinatus*, *Chonetes coronatus*, and *Pentamerella pavilionensis*. Of the Lamellibranchs which are abundant in the New York Hamilton we have in the Sellersburg beds *Pterinea flabella*, *Modiomorpha concentrica*, and *Aviculopecten princips*. Many other species occur in these beds which are common both to the Hamilton and Corniferous of New York. In southern Indiana this fauna is not mingled with the Corniferous, as was once supposed, but occurs above that fauna in the Sellersburg beds. The presence in it of such characteristic Hamilton fossils as those mentioned seems to leave no doubt of its equivalence to the New York Hamilton. This fauna may be designated as the *Spirifer granuliferus* zone of the Mesodevonian.

The New Albany shale has offered a more difficult problem in correlation than has either of the other Devonian formations. When the first attempts were made to correlate it with the New York scale its known fauna was limited to one or two *Lingulæ*. The Hamilton fauna at its base had not been recognized and the formation was correlated mainly on stratigraphic grounds with the Marcellus.

Carboniferous faunas appear immediately above the New Albany shale in Indiana and Kentucky, but they have nowhere been found in it by the writer.* The following is a list of the rather meagre fauna at present known from the New Albany shale in Indiana and central Kentucky†:

Barroisella subspatulata, *Cardiopsis* sp., *Chonetes lepidus*, *Chonetes scitulus*, *Discina minuta?*, *Discina truncata*, *Leiorhynchus limitare*, *Leiorhynchus quadricostatum*, *Lingula ligea*, *Lingula spatulata*, *Panenka radians?*, *Styliola fissurella*.

A summary of the evidence which these species afford as to the age of the fauna shows that the range of three of them is from the Marcellus or Hamilton to the Chemung and of one, from the Hamilton to the Portage, inclusive. Leaving out of consideration *Panenka radians* and *Discina minuta*, which have been doubtfully identified, and *Barroisella subspatulata*, which is not known in the New York faunas, we find but one of the species limited to beds below the Genesee. Of the others, one is common to the Portage and the Genesee; another ranges throughout the Hamilton, while three are characteristic Genesee species. The weight of the evidence seems therefore in favor of the equivalence of the faunas of the Genesee and the New Albany shale.

Probably no other species occurs in such abundance in the New Albany shale as *Styliola fissurella*. The fauna may be conveniently designated as the *Styliola fissurella* zone of the Devonian in this series of sections.

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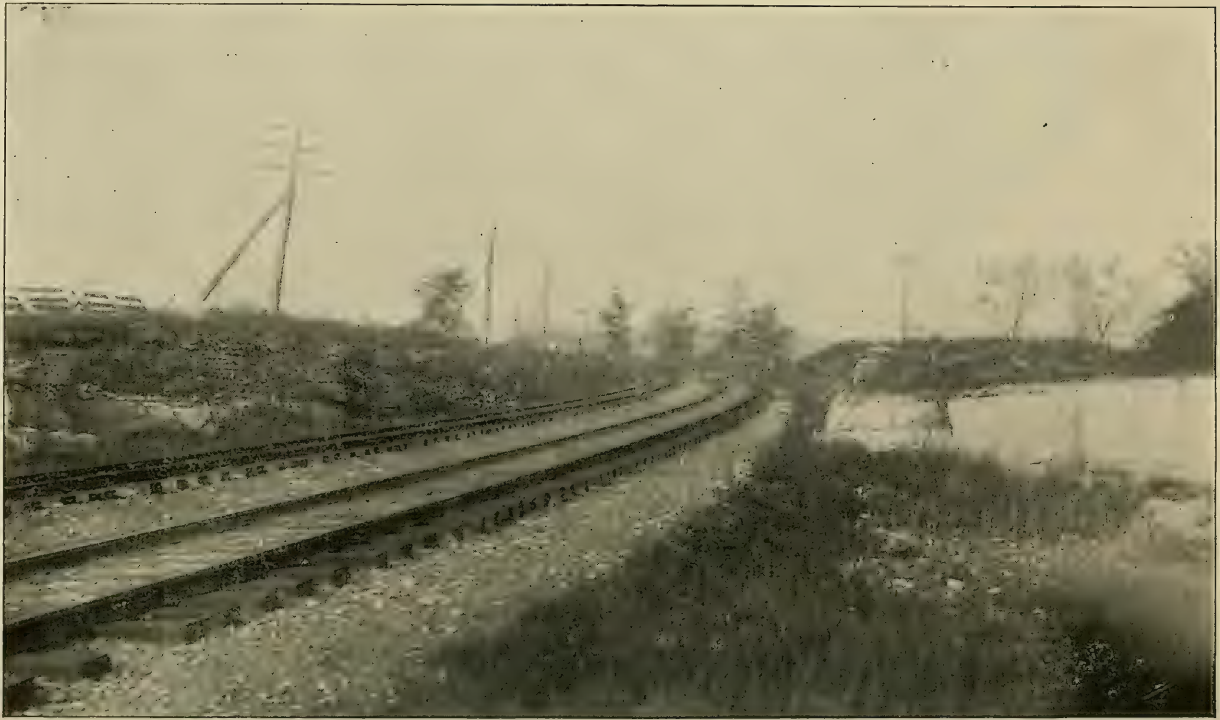
*Prof. Williams reports a Carboniferous fauna in the Black shale at Irvine, Ky. Am. Jr. Sci., 4th ser., vol. 3, p. 398.

†A few species not included in this list have been reported by Girty from the Black shale of eastern Kentucky. Am. Jr. Sci., vol. 6, 4th ser., pp. 384-395.



Cut on West Shore Railroad. Wemple Farm, near Ft. Hunter, N. Y.

Vol. 3.

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No. 13

THE CALCIFEROUS OF THE MOHAWK VALLEY

BY

H. F. CLELAND, Ph. D.

November 30 1900

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Cornell University
Ithaca, N. Y.
U. S. A.

ERRATA.

The volume paging of Bulletin 13 is erroneous, and should be corrected as follows:

120 to **248**
121 to **249**
122 to **250**
123 to **251**
124 to **252**
125 to **253**
126 to **254**
127 to **255**
128 to **256**
129 to **257**
130 to **258**
131 to **259**
132 to **260**
133 to **261**
134 to **262**
135 to **263**
136 to **264**
137 to **265**
138 to **266**

THE CALCIFEROUS OF THE MOHAWK VALLEY

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H. F. Cleland, Ph. D.

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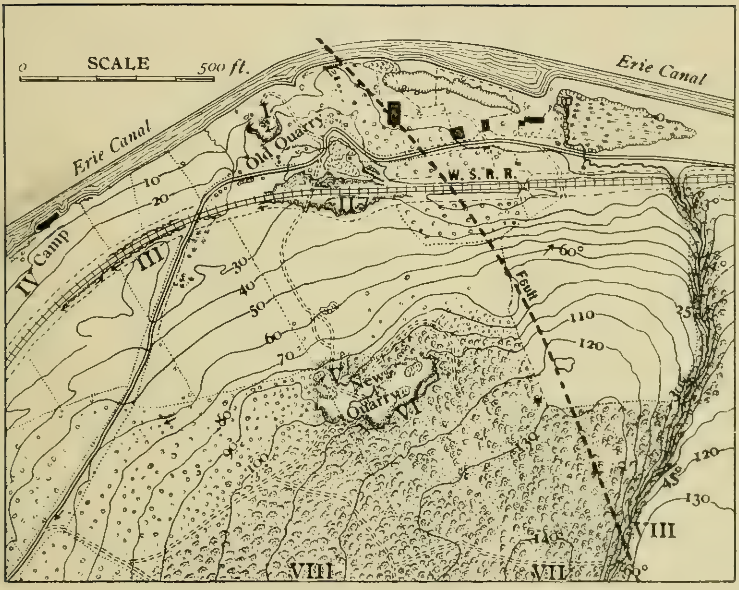
0 SCALE 500 ft.
Erie Canal
Erie Canal
Old Quarry
W. S. R. R.
Camp
IV
III
II
Fault
New Quarry
V
VI
VII
VIII
VIII
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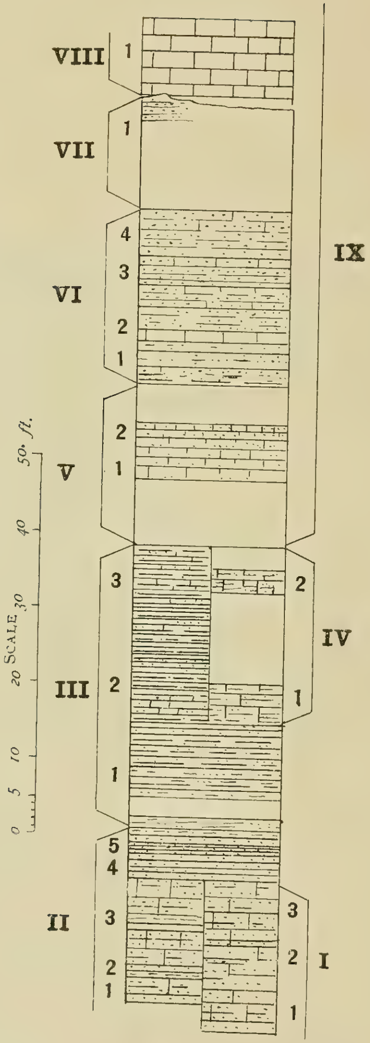
Map of the Fossiliferous Outcrops East of Ft. Hunter
New York


VIII
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40
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Section 1 Mile East of Ft. Hunter N. Y.

EXPLANATION OF SECTION

(See Plate 14 a.)

About one mile east of Ft. Hunter. Lat. 42° 57′, Long. 74° 16′; Florida township, Montgomery Co., N. Y.

I. Old Wemple quarry by canal, beginning at level of surface of canal.

1. Shaly, calcareous sandstone layers, weathering irregularly, changing from gray to yellowish in color.
2. As in 1, but containing obscure traces of *Ophileta*.
3. Within four feet of top ledges of quarry, *Ophileta* and other fossils observed. Surfaces weather very irregularly. Gray calcareous sandstone, traceable to railroad cut.

II Quarry by railroad track, beginning with lowest bed exposed; concretionary disturbances frequent and of considerable magnitude, especially towards eastern end of cut. Perpendicular joints few. Other running N.68° W. dip northeasterly at an angle of about 45°.

1. Blackish limestone, with clay laminæ, at lines of parting, sandy in spots. More sandy above.
2. As in 1, but with yellow ferruginous band, 4 inches thick at base and more or less yellowish throughout.
3. Ten feet of heavy-bedded grayish and sometimes yellowish mottled calcareous sandstone ledges. *Orthoceras* zone 2.7 feet above yellow band mentioned under 2. A second yellow band is 7 feet from top ledge of quarry.
4. As under 3, but becoming thin bedded and containing Cystidean remains in upper layers.
5. A sandstone ledge, with numerous specimens of *Syntrophia* at base.

III. 1, 2, 3. Thin-bedded layers of shaly sandstone, sometimes calcareous, exposed along railroad west of quarry; seen in Pl. 13 for one-fourth mile.

IV. Near canal, west of the curve in the railroad shown in Pl. 13, by old, decaying canal boat.

1. Calcareous, shaly and sandy, thin-bedded layers at edge of canal, with *Syntrophia*.
2. Slight outcrops in pasture south of 1, towards the railroad, with *Asaphus convexus?*, *Harrisia*, *et al.*

V. Lower part of large quarry south of railroad one-fourth mile. See map, Pl. 14, below the floor rock of quarry.

1. Firm, mottled, grayish calcareous sandstone layers.
2. Layer seen at the base (floor) and northern edge of quarry; about one foot thick, replete with Gastropoda, with *Asaphus canalis*, *et al.*

VI. Southern margin, escapement, of quarry.*

1. Gray sandy layers, 6 feet in thickness.
2. A layer with a few fossils. *P. hunterensis*, *E. multiseptarius*, *et al.*
3. Typical Calciferous sandstone layers containing an abundance of *Ribeiria*.
4. Same typical Calciferous sandstone as in 3.

VII. The highest ground shown in the map (Pl. 14) is underlaid by Calciferous sandstone. Along the southern limit of the map there is, generally, a slight S. W. dip, so that just to the west of the stone fence the Calciferous passes under the quarries in the Trenton limestone. In the S. E. portion of the map the dip changes to E. N. E., caused by the fault passing from there N. N.W. to and beyond the E. end of the railroad quarry shown in Pl. 13. East of fault line the bedrock is mostly Utica shale, though a little Trenton limestone is exposed in the very southeast corner of the map.

VIII. Quarries in Trenton limestone best seen just south of the area shown in map.

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*Beds VI 2 and 3 are seen in the nearly vertical walls of the quarry. *E. multiseptarius*, *P. floridensis* were collected from a projecting ledge of VI 2. This ledge is probably a continuation of the stratum exposed about 1000 feet N. E. of the quarry containing *E. multiseptarius*.

The most fossiliferous bed of the section is the 1 ft. 10 in. of VI 3, well exposed on the western half of this escapement and also on the W side of the quarry. The fossils obtained from this stratum are, in order of abundance, *Ribeiria*, *Ophileta*, *Asaphus*. These fossils are often colored green, the color being due to the presence of copper. The limestone when weathered crumbles readily, making collecting especially easy.—*From notes of J. Pacheco, C. U. '02.*

INTRODUCTION

The Cornell Summer School of Geology, under the direction of Prof. G. D. Harris, had, as one of its objects, the correlation, if possible, of the Calciferous of the Mohawk Valley with the divisions of the Lake Champlain Calciferous, as determined by Professors E. Brainard and H. M. Seely*. For this purpose the type localities of Shoreham, Vt., Ft. Ticonderoga, N. Y., and others along Lake Champlain were visited. After an examination of the type sections the party studied the Calciferous in the Mohawk Valley. Several outcrops of this stage on the route were examined. It was while doing this work that the extremely fossiliferous locality near Ft. Hunter was discovered, as well as a fossiliferous stratum near the top of the hill south of Little Falls, N. Y. Although the party did not succeed in correlating the divisions of the Lake Champlain Calciferous with those of the Mohawk Valley, the discovery of these two outcrops in a region which has been considered so poor in fossils justified the expenditure of time and effort.

Through the kindness of Prof. G. D. Harris, all of the material collected at the Ft. Hunter locality was turned over to the writer for study, and every facility given for carrying on the work.

Thanks are due Prof. C. E. Beecher, to whom the identifications of the trilobites were referred; to the students of the summer school, and especially to Prof. Harris, who figured the fossils and with A. C. Veatch prepared the topographic sheet and section, and through whose kindness this paper was made possible.

---

*Am. Mus. Nat. His. Bull., vol. 3, pp. 1–23, 1890–91.

HISTORICAL SKETCH

The rocks of the Calciferous stage were first described by Amos Eaton* (1824) as "an aggregate of quartsose sand and fine grains of carbonate of lime." The locality mentioned by Eaton as the most perfect, as well as the most accessible to those who travel the canal, is Flint Hill, in Florida township (the township in which our section is situated).

Conrad† (1837) states: The first rock which appears above the Gneiss in our [3rd] district is called the "calciferous sand-rock * * * the general inclination of which is 4 or 5 degrees to SW., which causes the rock to be lost to observation to the south of the Mohawk. Dislocations or faults and curves in the stratification are common."

In a summary of the geologic stages of the the third district, Vanuxem‡ (1838) makes the following statement: "Fossils, other than Fucoids of the largest species, are exceedingly rare [in the Calciferous]. I found two or three specimens; they were casts of small univalves * * * likewise two fragments belonging to crustaceæ; all these specimens were found in an upper layer of the rock."

His final report|| (1842) of the Calciferous contains a very detailed description of the lithological characters of the rock. The stage is divided into "three distinct masses as to character and position. The first is siliceous and compact, and may be a continuation of the Potsdam Sandstone, either in part or almost wholly. The second is a variable mixture of fine yellow siliceous sand and carbonate of lime, which when fractured presents a fine sparkling grain. This is the mass whence the name *Calciferous sand rock* was derived. The third is a mixture of the calcareous material, which is usually yellowish, very sparkling when fresh broken, and of compact limestone, which resembles the birdseye in mineral character, containing also some argillaceous or slaty matter. The whole mass has been designated, in the annual re-

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*A Geological and Agricultural Survey of the district adjoining the Erie canal, 1824.

†1st Ann. Rept. Geol. Sur. of the 3rd Dist. N. Y., 1837, p. 162.

‡2nd " " " " " " " " " " 1838, p. 283.

||Geol. of 3rd Dist. N. Y., 1842, Lardner Vanuxem, p. 30.

ports, by the name Fucoidal layers." It is to this division of Vanuxem that C. S. Prosser* refers the Calciferous of our section. In writing of this layer Vanuxem further says: "Besides fucoids it contains other fossils, many of which are peculiar to the rock; they appear to be more numerous where the birdseye mixture exists." The wood cut which follows "exhibits four of the most characteristic fossils of the group," viz: 1, *Ophileta levata;* 2, *O. complanata;* 3, a crinoid plate; 4, *Orthoceras primigenium.*

James Hall† was of the opinion that "from the nature of the rock, and from the condition of many of its fossils, we cannot doubt but many more forms, both of plants and animals, were imbedded in it than we find at the present time." In the same volume twelve species are figured, of which four are from loose boulders or doubtful localities.

In 1879‡ C. D. Walcott described six species, without figures, from Saratoga Co.

Between 1881–91 J. M. Whitfield|| figured and described a large number of fossils, collected by Brainard and Seely, from the Calciferous of Lake Champlain.

Prof. W. B. Dwight¶ of Vassar in 1884 described eight new species from the Calciferous of Wappinger Valley at Rockdale, N. Y.

In his report on the "Lower Silurian Sections,"§ C. S. Prosser makes no mention of fossils, although he describes the quarry and railroad cut from which our fauna was obtained. Up to the present time the number of species from the Calciferous of the Mohawk Valley has not been materially increased since the publication of Vol. 1, Pal. N. Y.

In this paper twenty-two species are described from this stage, of which one genus, 15 species and one variety are figured and described for the first time.

*Rept. of the State Geol. N. Y., vol. 1, 1895. Sections and thickness of the Lower Silurian Formations on West Canada Creek and in the Mohawk Valley, p. 646.

†Pal. N. Y., vol. 1, p. 5, 1847.

‡N. Y. State Mus. Nat. His. Rept. 32.

||Am. Mus. Nat, His. Bull., vols. 1, 2, 3.

§Prosser, Rept. Geol. N. Y., vol. I, 1895.

¶Am. Jour. Sci., 3rd series, vol. 27, pp. 249, 259.

CONCLUSION

The Ft. Hunter fauna is, as far as our present knowledge goes, an isolated one, bearing a resemblance to both the Point Levis fauna* and that of the Lake Champlain Calciferous†. As one would expect from the geographical position of these localities, it is more closely related to that of the Lake Champlain region. It is remarkable that the geographical distribution should show such wide differences in the faunas of these localities and that of Rockdale, N. Y.‡. The stratigraphic position and the contained fossils leave little or no doubt as to the correctness of the correlation.

The discovery of this fossiliferous outcrop and that at Little Falls makes it probable that further search will bring to light other interesting localities.

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*Pal. Fos., vol. 1, 1861–1865.

†Am. M. N. H. Bull., vol. 1, 2, 3, 1881–91.

‡The Point Levis fossils (from Point Levis, opposite the city of Quebec) were described by Billings in the Can. Nat. and Geol., vols. 4, 5 and 6, and in Pal. Fos., vol. 1, 1861–5; the Calciferous from Rockdale, Duchess Co., N. Y., by Dwight in the Am. Jour. Sci., 3rd ser., vol. 27.

NOTE.—Clarke and Shuchert suggest the name Beekmantown for this stage. The reason for this change is "to remedy the present incongruity in the nomenclature of the stratigraphic units. As the propriety and necessity of local terms for the designation of such units is generally acknowledged, those formations which have hitherto borne names of other significance are now superseded by appropriate geographic names. This formation took its original name from sections in the Mohawk Valley, where the rocks are without fossils. At Beekmantown the normal fauna is finely developed and the rock section essentially complete.": Am. Geol., vol. 25, No. 2, p. 116.

A DESCRIPTION OF THE FOSSILS FROM NEAR FORT HUNTER, NEW YORK*

ECCULIOMPHALUS Portlock

Ecculiomphalus multiseptarius, n. s., Pl. 15, figs. 1, 2, 3, 4

Shell discoid, loosely coiled, volutions two or more, slender and gradually expanding until, in a specimen 20 mm. in diameter, the outer coil is 6 mm. in diameter; the transverse section of the outer coil is subovate with a tendency to carination on the outer edge. The internal structure, seen in weathered specimens, is at first puzzling. The well developed partitions present, in the natural sections, the appearance of a cephalopod. This is well illustrated by Plate 15, figure 2; the irregularity and great curvature of the partitions distinguish it from that class. A number of small specimens averaging 5 mm. in diameter are probably young forms of this species.

The specimens at hand differ from *E. priscus*, Whitfield, in the more gradual increase in the size of the coils, in the absence of liration, and in the presence of partitions. These last two characteristics may, however, be due to the state of preservation. This shell differs from all others to such an extent that it is necessary to refer it to a new species.

Diameter of a medium specimen, 20 mm.; of a young shell, 5 mm.

Locality.—Bed V 2, near Ft. Hunter.

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*All the fossils herein described and figured are in the Paleontological Museum of Cornell University.

OPHILETA Vanuxem

Ophileta discus, n. s., Pl. 15, figs. 5, 6

Shell discoidal, concave on the lower side; spire slightly elevated; whorls four or more, with an elevated, sharp margin on the periphery; the upper side of the whorl flat, the lower rounded and somewhat angulate (see figure of lateral view, Pl. 15, fig. 5). Umbilicus wide, shallow, exposing all of the whorls.

Size, 10 mm. in diameter. This species resembles *Ophileta ottawensis* Billings, but is much smaller, the spire is slightly elevated, and the lower side of the whorl more angulate.

Locality.—Extremely abundant in bed No. V 2, of the Ft. Hunter section.

Ophileta complanata Vanuxem, Pal. N. Y., vol. 1, p. 11, Pl. 3.

A number of specimens which are undoubtedly the same as those referred to this species by Vanuxem and Hall were found in the weathered surfaces of the rock. In every specimen the surface markings were obliterated.

PLEUROTOMARIA Defrance

Pleurotomaria hunterensis, n. s., Pl. 17, figs. 1, 2, 7, 8

Shell conical; spire elevated; umbilicus more than one-half as wide as the whole diameter of the shell; volutions in one specimen more than six, the upper side nearly flat with a faint groove near the edge, the under side slightly angulate; aperture irregularly rhomboidal. The size varies greatly, the largest specimen included in this species being 40 mm. in diameter, the smallest 10 mm., the average is about 20 mm. It is possible that the large specimen, Pl. 17, figs. 1, 2, may not be of the same species as the smaller and more abundant forms, figs. 7, 8, but, until more specimens are collected, it seems best to include them in one species.

This species resembles *P. etna* Billings*, but differs from it in the greater obtuseness of the apical angle, which is 65°–95° in *P. etna* and 108°–120° in our species; in the umbilicus, which is more than one-half the width of the shell in *P. hunterensis*, and one-third the width in *P. etna*.

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*Geol. of Can., Pal. Fos., p. 226, fig. 210.

Locality.—Not common in the section. The large specimen (figs. 1, 2) was found in VI 2, the smaller ones in V 2.

Pleurotomaria floridensis, n. s., Pl. 15, fig. 12

Shell small, conical, apical angle 44°; volutions five, trapezoidal in section; surface of volution slightly rounded; outer lip parallel to the surface of the upper whorls. Umbilicus minute. Total height of shell 4 mm. diameter at base 3mm.

This species differs from *P. beekmanensis*, Whitfield*, in its smaller size, smaller umbilicus, more acute apical angle, and in the surface of the volutions, which are sloping in *P. beekmanensis* and rounded in this species.

Locality.—Found near the top of V 2. A rare fossil at Ft. Hunter, Florida township, N. Y.

HOLOPEA Hall

Holopea turgida, Hall, Pl. 17, fig. 14

Pal. N. Y., vol. 1, p. 12, pl. 3.
Bull. A. M. N. H., vol. 2, p. 50, pl. 9, figs. 3-7.

A single imperfect specimen preserving two whorls answers the description given by Hall: "Depressed—conical; whorls about four, subangular, rapidly increasing from apex; last whorl very large, ventricose, expanded; height and greatest breadth about equal."

Size, 14 mm. in diameter.

Localities.—Reported by Hall from Saratoga Co., N. Y., by Prof. H. M. Seely from Beekmantown, N. Y. A single specimen was found at Ft. Hunter.

RAPHISTOMA Hall

Raphistoma obtusa, n. s., Pl. 15, figs. 7, 8, 9

Shell of medium size, much compressed, convex above; volutions three, the upper surface more compressed than the lower;

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*A. M. N. H. Bull., vol. 2, pl. 8, p. 53.

outer edge very acute, the inner rounded, the upper surface somewhat angulate next to the suture. The margins of the umbilicus are angular; umbilicus about one-third the width of the shell. Apical angle 130°.

This species resembles *R. prævium*, Whitfield, but differs in its smaller size and more obtuse apical angle.

Many of the specimens of this species are much water worn and are found associated with flat, water-worn pebbles.

Locality.—Very common in V 2 at Ft. Hunter, N. Y.

MURCHISONIA D'Archiac and Verneuil

Murchisonia mohawkensis, n. s., Pl. 15, fig. 13

Shell elongate, turbinate, spire somewhat rapidly ascending; volutions obtusely angular along the middle. None of the specimens show the complete shell or the surface markings. The specific characters are such that it cannot be included in any described species. Diameter of shell at the lowest whorl 6 mm.

Locality.—A very rare fossil. Found on the weathered surface of a slab found near the top of No. V. 2, associated with *Ribeiria (?) nuculitiformis*, *Pleurotomaria floridensis* and *Ecculiomphalus multiseptarius*.

BELLEROPHON Montfort

Bellerophon calcifer, n. s., Pl. 15, figs. 15, 16, 17, 18

Shell discoid. Six whorls are exposed in one specimen, but the number is usually less. Dorsum angulate. Vertical diameter of the specimen figured 8 mm. Umbilicus large, apparently exposing all of the whorls; width 3½ mm.

B. macer, Billings, resembles this species, but is larger, has a smaller number of whorls and a narrower umbilicus, otherwise the resemblance is strong. This species is extremely variable, approaching *B. subovata* in its ventricose forms, with a narrow umbilicus.

Locality.—No. V 2 of the Ft. Hunter section.

Bellerophon subovatus, n. s. Pl. 15, figs. 19, 20, 21

Sub-lenticular, dorsum varying from carinate to rounded according to the age of the shell; greatest width close to the umbilicus; vertical diameter of the largest specimen 9 mm., of the smallest 4 mm. Umbilicus small, sharply rounded on the edge; transverse section of the shell subovate.

This species bears some resemblance to *B. allegoricus* White, but is clearly a distinct species. Very variable. (See under *B. calcifer*, n. s.)

Locality.—Found in No. V 2 of the Ft. Hunter section.

STRAPAROLLUS Montfort

Straparollus parva, n. s. Pl. 15, figs. 10, 11

Shell small; whorls two and one-half, the upper being very small in proportion to the lower. Height 4 mm. A single specimen was found. This species resembles *S. hippolyte* Billings, from the Guelph stage, but is smaller with the lower whorl much larger in proportion to the size of the shell.

Locality.—Found in No. V 2 in the Ft. Hunter section.

Trilobita

HARRISIA--New Genus

Genal angles produced into spines, free cheeks united in front. Facial suture extending forward from the posterior margin of the cephalon along the eye lobes and uniting in front. Eyes oblong, minute.

Harrisia parabola, n. s. Pl. 16, figs. 1, 2, 3

Cephalon small, narrow, parabolic, sloping sharply at the side. Length, width and depth as 3½:7:4. Genal angles produced into spines. The margin turns up in front and presents the appearance of a truncation in front of the glabella.

Facial sutures extend forward from the posterior part of the cephalon within the genal angles, passing inward to the margin of the eye, than forward, almost to the margin of the cephalon, where they turn sharply and unite in front of the glabella.

Glabella small, gradually increasing in size from front to back, very convex, with two pairs of rather obscure lateral furrows. Cheeks depressed, sloping abruptly to the margin. Genal angles produced into sharp spines which are more than two-thirds as long as the glabella.

Eyes oblong, situated very far anteriorally, opposite the anterior one-sixth of the glabella, less than ½ mm. in length.

Thorax and pygidium unknown.

Locality.—No. IV 2 of the Ft. Hunter section.

ASAPHUS Dalman

Asaphus canalis (?) Conrad Pl. 16 figs. 7, 8

A. M. N. H., Bull., vol. 1, p. 336, pl. 34; vol. 2, p. 64, pls. 11. 12.

Several pygidia and free cheeks and one glabella of a species closely resembling *A.canalis* have been referred to that species.

The description is as follows: Cheek large, triangular in outline, projecting backward at the genal angle into a long, thick spine. The spine is rounded, but the thickening becomes more angular as the front of the cheek is approached. Length of largest cheek from the anterior to the end of the spine about 50 mm.; from the suture line below the eye to the margin 18 mm. Eyes prominent; the longest diameter 5mm.

Pygidium large, semi-circular, with a wide doublure; obscurely trilobed or almost perfectly convex, anterior margin nearly straight, axial lobe narrow, marked in one specimen by eight obscure annulations; in some specimens only four or five can be distinguished. In the pygidium of one large individual the axis is depressed. Size varies greatly, from 10 mm. in width and 7 mm. in length for the smallest and 50 mm. in width and from 38 to 40 mm. in length for the largest.

Locality.—No. V 2 of the Ft. Hunter section; not uncommon.

Asaphus convexus, ? Pl. 16 fig. 9

Pygidium semi-circular, convex, sloping evenly to the lateral but sharply to the posterior margin. Doublure strong but not so marked as in *A. canalis* or *gigas*. Axis broad, not strongly arched, tapering to a very obtuse termination; only three indestinct annulations can be distinguished. Varies in size from 7 mm. by 5 mm. to 21 mm. by 15 mm. Probably a new species.

Locality—Found in No. IV of the Ft. Hunter section.

BATHYURUS (?) Billings

Bathyurus sp. ? Pl. 16 fig. 9

Glabella oblong, very convex; eyes midway between the front and back. Surface smooth. Size of glabella 12 mm. in length and 7 mm. in width. Several glabella were found, but none in a condition perfect enough to warrant a positive identification.

Locality.—No. IV 2, of the Ft. Hunter section.

Bathyurus ellipticus, n. s. Pl. 16, figs. 5, 6

Glabella very convex, elliptical, length slightly exceeding the width, destitute of lateral furrows. Neck furrow well defined. Margin of the glabella with a thick, narrow border which turns up in front, presenting a truncated appearance. In the imperfect specimens at hand a triangular portion of the fixed cheek curves down behind the eye.

Eyes situated midway between the front and back.

Surface covered with strong, numerous tubercles. Width of cephalon about 10 mm., length 7 mm.

This species differs from *B. conicus* Billings, in that the glabella is elliptical and in the turning up and seeming truncation of the anterior margin of the cephalon. A comparison of one of the type specimens of *Menocephalus globosus* Billings, kindly loaned by Prof. J. F. Whiteaves, showed a strong resemblance to our species. The cephalon of *M. globosus* is more globose, the tubercles are smaller and less numerous and the sutures extend directly back from the eyes to the posterior of the cephalon. In *B. ellipticus* the fixed cheeks extend in a narrow wedge to the side of the cephalon.

Locality.—Very rare in bed VI 2, near Ft. Hunter.

Brachiopoda

DALMANELLA Hall and Clark

Dalmanella (orthis) wemplei, n. s. Pl. 17 figs. 10, 11, 12, 13

Shell small, sub-circular, bi-convex; hinge line from four-fifths to equal the greatest width of the shell; cardinal angles slightly rounded. Pedicle valve convex, in some specimens somewhat carinate, beak projecting beyond the hinge line, brachial valve much less convex and with a distinct mesial depression along the middle of the valve. Surface marked by fine, radiating striæ of two kinds, the stronger alternating with from two to four smaller ones, which increase by bifurcation and implantation.

This species resembles *O. macleodi* Whitfield, but has not the same arrangement of the striæ.

Locality.—Found near Ft. Hunter, N. Y., in No. IV 2.

Dalmanella holiensis, n. s. Pl. 17, fig. 9

Shell sub-circular, hinge line less than the greatest width of the shell. Cardinal angles rounded. Ventral valve convex, with the greatest convexity near the beak. Beak extending somewhat beyond the hinge. Surface marked by strong, radiating striæ which bifurcate from two to three times near the front of the shell. Length and breadth 7 mm. This species differs from *D. wemplei* in having coarser and fewer striæ.

Locality.—No. IV 2 of the Ft. Hunter section.

SYNTROPHIA Hall and Clark

Syntrophia palmata, n. s. Pl. 17, figs. 14, 15, 16, 17

Shell of medium size, moderately convex, length to width as 9 to 11. Hinge straight, almost as long as the width of the shell. Ventral valve with a wide, poorly defined sinus which can not be distinguished near the beak.

Shell substance fibrous, which, in partially exfoliated specimens gives a concentric appearance as shown in fig. 14.

In exfoliated specimens peculiar radiating lines are shown which are probably impressions of the vascular sinuses. This is shown in figs. 15 and 17.

Size 11 mm. in width, 9 mm. in length.

This species bears a strong resemblance to *Triplesia* (*Syntrophia*) *lateralis* Whitfield.

Locality.—In Nos. II 5 and IV 1 of the Ft. Hunter section.

LINGULA Bruguiere

Lingula, *cf.* **L. iole** Billings

Pal. Fos., vol. 1, 1861–65, p. 215, fig. 199.

A small lingula of which both valves are retained was found. It is closely related to *L. iole* of Billings, but can not be included in that species with certainty.

Locality.—Found near Ft. Hunter.

Echinodermata

Crinoid Stem and Plates

Pl. 16, figs. 16, 17, 18

A number of excellently preserved plates probably of cystideans were found on weathered slabs of impure limestone. They were, however, not sufficient for specific or generic identification.

Locality.—Calciferous, near Ft. Hunter, N. Y.

Cephalopoda

CYRTOCERAS Goldf.

Cyrtoceras kirbyi (?) Whitfield Pl. 17, Figs. 3, 4

A. M. N. H. Bull., vol. 2, p. 57, Pl. 10

A specimen which has been doubtfully referred to this species is as follows: Shell almost straight (this may be due to pressure). Transverse section broadly oval, tube gradually enlarging. Septa strongly concave, almost angulate on the side, strongly arching on the back of the shell.

Air chambers numerous, having a depth of somewhat less than 1 mm. where the longer diameter is 12 mm. and the shorter 7 mm.

Locality.—No. VI 2 of the Ft. Hunter section.

Cyrtoceras sp. (?) Pl. 17, figs. 5, 6.

A small specimen 12 mm. long and 8 mm. in diameter with 5 septa to 3½ mm. can not be placed with any described species.

It may be a variety of *C. microscopicum* Dwight*, but is larger and has wider air chambers. *C. dictys* Billings†, is a larger shell, the septa in a shell twice as large as ours has air chambers of the same size.

Locality.—Found in bed V 2, near Ft. Hunter, N. Y.

ORTHOCERAS Breynius

Orthoceras primigenium Vanuxem

Pal. N. Y., vol. 1, 1847, p. 13, Pl. 3.
Am. M. N. H. Bull., vol. 2, p. 56, Pl. 10.

Hall's description is "elongated, terete, gradually tapering to an obtuse point; section circular; septa thin, deeply concave, closely approximated, being distant only 1-25 the diameter"

A few imperfect specimens were found in the Ft. Hunter section. No. II 3

Pelecypoda

RIBEIRIA Sharpe

The class relationship of this genus has been discussed both by Billings and Whitfield.

In the original description of the genus Sharpe (Geol. Jour., vol. 9, p. 157, Pl. 9, 1853) says- "This curious shell appears related to the family Calyptræidæ * * * It is equilateral, and both the transverse internal plate and muscular attachment are placed along the middle of the back of the shell; the external form may be described as a Calyptræa pressed together laterally till the sides nearly meet, leaving only a narrow opening for the foot of the animal."

Billings (Pal. Fos. vol. 1, 1861–65, p. 339) states that "in general character his species agrees with the descriptions of Sharpe, but that the internal cast does not exhibit the muscular impression."

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*Am. Jour. Science, 3rd series, vol. 27, p. 256, fig. 11.
†Pal. Fos., vol. 1, p. 192, fig. 176.

His argument for Pelecypod relationship is based on the presence of a small aperture of semi-circular shape "just beneath the umbo and in front of it which appears to be the entrance to a tubular passage running backwards over the transverse plate into the general cavity of the body." This cavity he supposed "served the function of a byssal orifice and that these species were anchored by a byssus passing through the beak." He placed his species in the genus *Ribeiria* provisionally and proposed the name *Ribeirina* if further examination showed a separation necessary.

After a full discussion of the genus, Whitfield (A. M. N. H., vol. 1, p. 343, 1881–86) says: "I think there can be no question about their relationship to the Ceratiocaridæ (or Phyllocaridæ, if we adopt Prof. Packard's new name)."

In Eastman's translation of Zittel's Text Book of Paleontology, 1899, is this statement: "There is no satisfactory evidence of their Crustacean nature."

Our species belongs to that division of the genus to which *R. califer* Bill., *R. longiuscula* Bill. and *R. compressa* Whit. are referred. Without going into a further discussion of the relationships, it should be said, however, that there is so much doubt as to the correctness of the identification with Sharpe's genus that we refer our species to it with a great deal of doubt.

Ribeiria (?) nuculitiformis, n. s., Pl. 16, figs. 10, 11, 12, 13, 14

Shell small, resembling, in general appearance, a nuculite. Compressed laterally; about one-half as high as long. Dorsal margin concave, sides convex. In the casts of the shell the anterior is rounded, with a deep notch just below the beak. Notch about one-quarter as long as the shell, extending obliquely toward the middle of the ventral side. The shell is not bilaterally symmetrical. From Pl. 16, fig. 12, it will be seen that there is a sinus and fold on the right side and a corresponding fold and sinus on the left.

Surface smooth as far as known.

This species resembles *R. calcifer* Bill., but differs in the presence of the fold near the dorsum and in the depth of the notch.

Size varies from 1½ mm. wide by 3 mm. long to 6 by 12 mm.

An extremely abundant fossil in bed VI 3 and occasionally found in V 2 of the Ft. Hunter section.

R. nuculitiformis var. **equilatera** (?) Pl. 16, fig. 15

Shell as above, but without the fold. The dorsum is straighter than in *R. nuculitiformis*.

Rare in the Calciferous at Ft. Hunter, N. Y.

Cœlenterata

Monticulipora (?) sp.

A specimen resembling the branching forms of *M. lycoperdon* Say was found in the Ft. Hunter section. The specimen is a cast of the interior, the original material having been dissolved away. Until more and better material is found it will not be possible to make a definite determination.

Explanation of Plates

EXPLANATION OF PLATE 15

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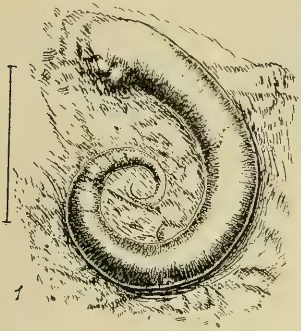
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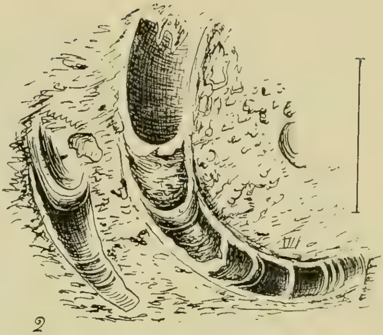
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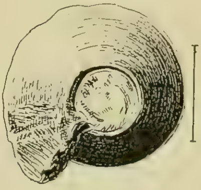
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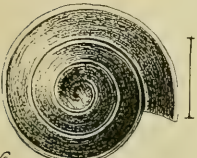
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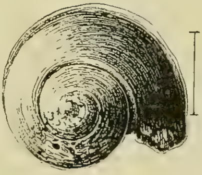
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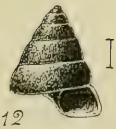
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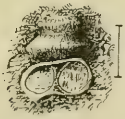
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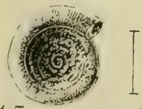
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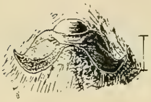
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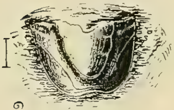
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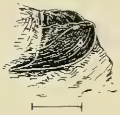
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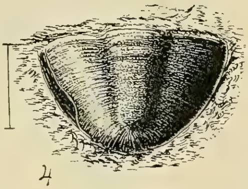
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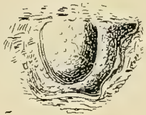
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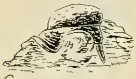
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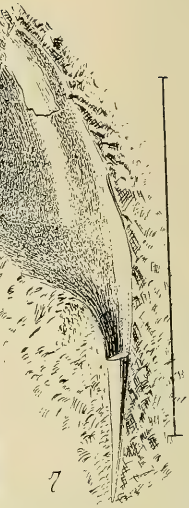
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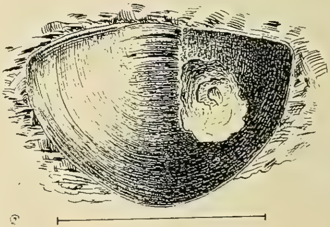
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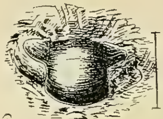
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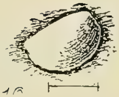
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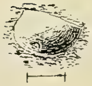
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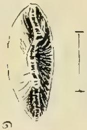
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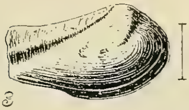
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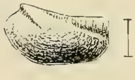
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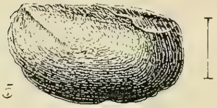
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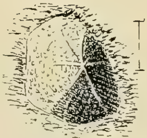
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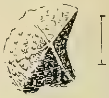
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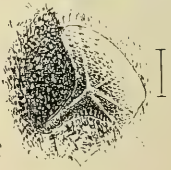
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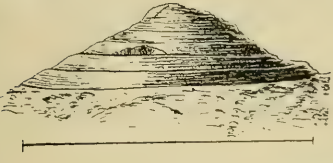
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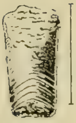
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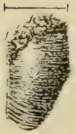
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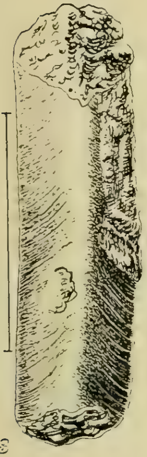
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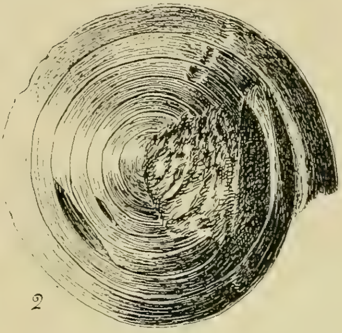
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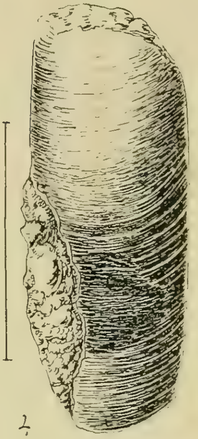
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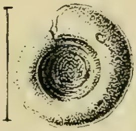
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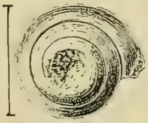
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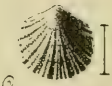
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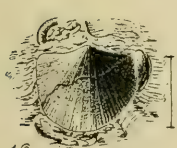
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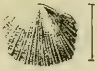
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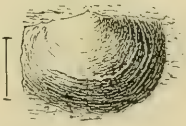
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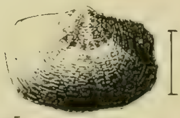
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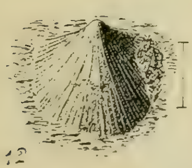
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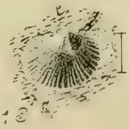
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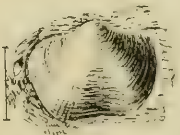
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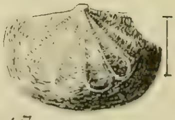
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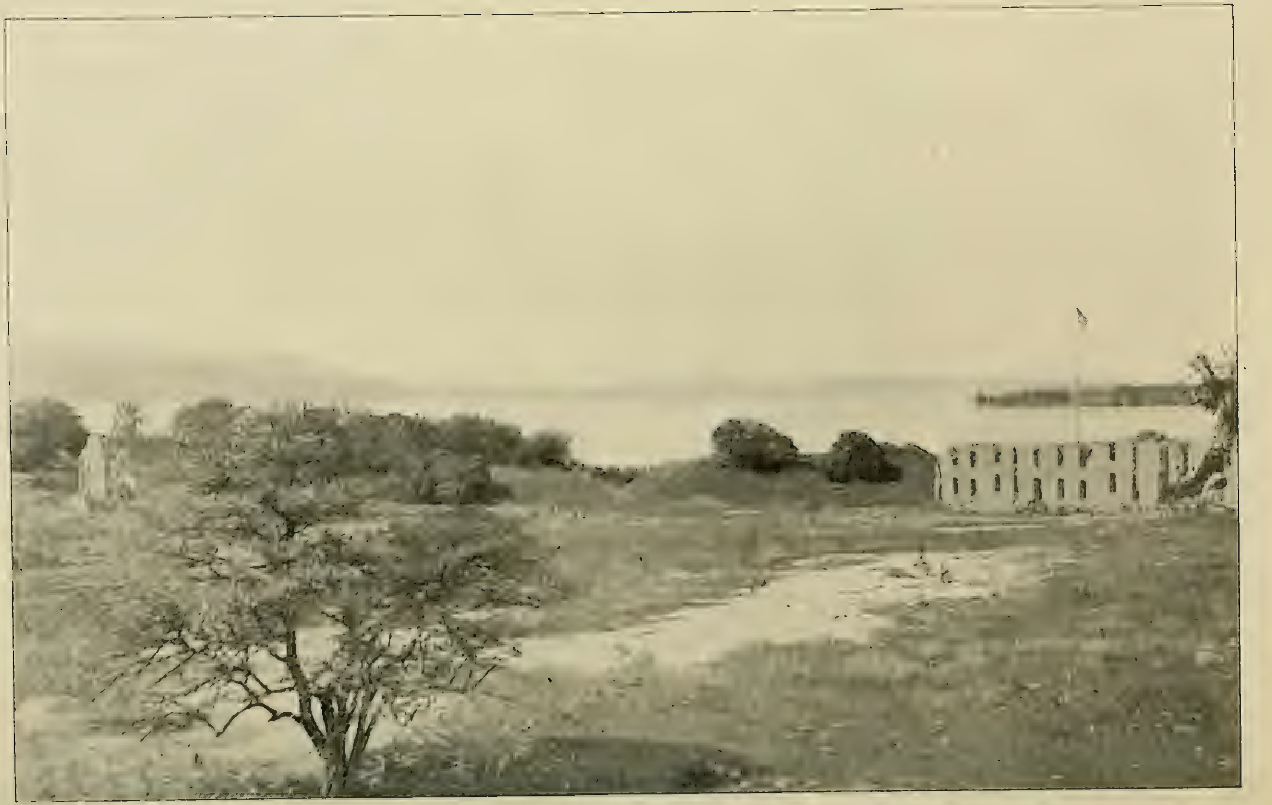

Top of the Chazy Limestone, Ruins at Crown Point, N. Y.

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No. 14

THE CROWN POINT SECTION

by

PERCY E. RAYMOND.

April 1, 1902.

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Ithaca, N. Y.
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THE CROWN POINT SECTION

by

PERCY E. RAYMOND.

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INTRODUCTION

Crown Point has long been known as a region of great geological, as well as historical interest. Many writers have spoken of the opportunities there afforded for studying the Ordivician and its characteristic fossils. For this reason, the Cornell Summer School of Field Geology has made it a stopping place on its Champlain trip for the past two years, and, during a stay of several days in the summer of 1901, the following detailed section was made. The collecting from the Chazy and Black River limestones was done by J. Pacheco, C. U. '03, and the writer. The Trenton was worked by C. E. Smith, Graduate, T. Wilson, '02, and C. H. Presho, '03, the first two gentlemen completing the identification for the faunal lists of that part. The maps and plates are the work of Prof. G. D. Harris, to whom many thanks are due for favors in connection with the work and publication.

The peninsula of Crown Point, or Long Point, as it is called locally, juts out into Lake Champlain about five miles north of the village of the same name in Essex County, N. Y. It is approximately a rectangle, two and a half by one mile, bounded on the north and east by the lake and on the west by Bulwagga Bay. The whole point is low and nearly level. The highest part is at the northern end, where the ruins of the old English fort of Crown Point (built 1750) stand. The underlying rock is exposed frequently along the whole shoreline, and ledges often show through the thin coating of Champlain clays which forms the soil. The average dip of these rocks is from six to eight degrees in a northwesterly direction.

The formations represented are first, the Calciferous, which underlies the southern half of the peninsula and is very fossiliferous at an outcrop near the road about a mile south of the ferry landing. *Ecculiomphalus triangulatus* Whitf., *Polytœchia apicalis* Whitf., *Asaphus canalis* Conrad and a small species of *Maclurea* are the common fossils. Overlying it are the lower slaty layers of the Chazy, whose contact is shown on the east shore of Bulwagga Bay about three-fourths of a mile southwest of the fort. North of this nearly the whole point is underlaid by Chazy limestone, which, however, dips under the Black River beds near the northern entrance to the English fort. The Black River is well shown for its entire thickness, 67 feet, and fine opportunities afforded for collecting its numerous fossils in the outcropping ledges and old "marble" quarry between the fort and the rubble dock northwest of it. To the Black River succeeds the Trenton, with a break of only four feet of covered strata between them. Fine collecting may be had along the shore, where 90 feet of the layers are exposed, or in the farm orchard, which is underlaid by the same rock, and where there are many outcrops. Across the lake, on Chimney Point, the top layers of the Chazy, the Black River and the Trenton are shown. The Chazy is cut off on its eastern side by a fault which is seen on Crown Point a few feet east of the lighthouse and whose general direction is about N. 20° E. On the Point the upper layers have been thrown down to the east of the fault line, the throw, judging from the character of the rock and the fossils, probably not exceeding 100 feet.

As a result of glacial action, the limestones in many places are planed off and almost polished. The directions of the striæ vary a few degrees. The limits are S. 34° W. and S. 28° W. for the stronger set. The smoothing and gouging is best shown along the shore to the east of the lighthouse.

HISTORICAL

The first geologist to visit this section appears to have been Prof. Pehr Kalm of the University of Aobo, in Swedish Finland. The account of his travels in North America was published first in Swedish and translated into English by John Reinhold Forster in 1770. Prof. Kalm gives the following description of the geology of the vicinity of Ft. St. Frederick,* where he spent some time in July, 1749:

"The mountains on which Ft. St. Frederick is built consisted generally of a deep black limestone, lying in lamellæ, as slates do, and it might be called a kind of slate which can be turned into quicklime by fire. This limestone is quite black in the inside and when broken appears to be of an exceedingly fine texture. There are some grains of dark spar scattered in it, which, together with some other inequalities, form veins in it. The strata which ly uppermost in the mountains consist of a grey limestone, which is seemingly no more than a variety of the preceding. The black limestone is constantly found filled with petrefactions of all kinds, and chiefly the following: Pectinites, or petrified Ostriæ Pectines.† These petrified shells are more abundant than any others that have been found here, and sometimes whole strata are met with, consisting merely of a quantity of shells of this sort grown together. They are generally small, never exceeding an inch and a half in length. They are found in two different states of petrefaction; one shews always the impressions of the elevated and hollow surfaces of the shells, without any vestige of the shells themselves; in the other appears the real shell sticking in the stone, and by its light color is easily distinguishable from the stone. Both these kinds are plentiful in the stone; however, the impressions are more in number than the real shells. Some of the shells are very elevated, especially in the middle, where they form, as it were, a hump; others, again, are depressed in the middle; but in most of them the outward surface is remarkably elevated. The furrows always run longitudinally, or from the top, diverging to the margin. Petrified Cornua ammonis. These are likewise frequently found, but are not equal to the former in number. Like the pectinitæ, they are found really petrified and in impressions; amongst them were some petrified snails. Some of these Cornua Ammonis were remarkably big, and I do not remember seeing their equals, for they measured above two feet in diameter."

---

*Fort St. Frederick is situated a few rods to the northeast of the English fort (see map). It was built by the French in 1730 and held by them for about 20 years.

†*Rafinisquina alternata* answers this description very well.

"Different kinds of corals could be plainly seen in and separated from the stone in which they lay. Some were white and ramose, or Lithopytes;* others were starry corals, or Madrepores.† The latter were rather scarce."

"I must give the name of stone-balls‡ to a kind of stones, foreign to me, which are found in great plenty in some of the rock-stones. They were globular, one-half of them projecting generally above the rock and the other remaining in it. They consist of nearly parallel fibres, which arise from the bottom as from a center and spread over the surface of the ball and have a grey color. The outside of the balls is smooth, but has a number of small pores, which externally appear to be covered with a pale grey crust. They are from an inch to an inch and a half in diameter."

The above is quoted so fully on account of its historic interest, as showing the state of knowledge of paleontology in the middle of the eighteenth century.

Prof. Emmons speaks of the section in his final report of the second district of New York (1842). He considers the rocks at the extreme end of Long Point to be Chazy underlying a thin portion of Trenton, the Birdseye being wanting. In speaking of the black limestone, he says:

---

*Probably Prof. Kalm refers to the ramose form of *Monticulipora lycoperdon*.

†Possibly *Columnaria alveolata*.

‡This is a very good description, and the earliest, of the hemispheric form of *Monticulipora lycoperdon*.

"The upper surface of this rock is plated with a layer of chert, one or two inches thick, which is spread very evenly over almost the whole exposure of the rock at this point. This layer is smoothed and polished by drift which has been forced over it. * * * Following the shore along the bay, I found a stratum about one foot thick filled with lingulæ. They were confined wholly to this layer, and thousands of them could have been obtained, though from the thinness of the shell it is difficult to obtain them in a perfect state. That part of the rock which has been employed in the fortification is the Trenton limestone. As in the walls, the shaly part of the stone frequently contains *Trinucleus tesselatus* and *Orthis testudinaria*."

In a diagramatic section, from the town of Crown Point to the fortress, he gives the following in order from south to north:

Archæn,
Drift,
Potsdam sandstone,
Calciferous sandrock,
Drab-colored layers,
Fault,
Calciferous sandrock,
Chazy,
Birdseye,
Limestone with fucoidal layers.

In the Geology of Vermont (1861), Prof. Edward Hitchcock speaks of the Chazy as being "abundantly exposed" at Crown Point, and as part of an anticlinal which can be traced across the lake to Chimney Point, thence northward through the Vermont towns of Addison, Panton and Ferrisburgh into Charlotte. The following dips and strikes are given:

	Strike.	*Dip.*
Crown Point	N. 48° E.	9° N. W.
Chimney Point	N. E. & S. W.	8° N. W.

He mentions also the occurrence here of the Birdseye and Trenton and the great number of specimens of *Lingula crassa* Hall in the latter.

In 1891 President Ezra Brainerd[*] published a carefully measured section of the Chazy, which is as follows, the strata being given in ascending order:

A	1.	Sandstone and slate interstratified	23 feet
	2.	Impure limestone containing *Orthis platys*	25 feet
B		Beds containing *Maclurea magna*	200 feet
C	1.	Dark gray, massive limestone, weathering in darker stripes an inch wide, containing *Bucania* sp. und	40 feet
	2.	Tough, siliceous and magnesian rock, passing into a two-foot bed of pure sandstone	17 feet
		Aggregate thickness	305 feet

In a later paper[†] Professors Brainerd and Seely reprint this section with a geologic map of Crown Point, Chimney Point and Port Henry. They also mention the occurrence of the higher measures of Calciferous on the east side of the peninsula, the fossils seeming to indicate Group D. The Black River and Trenton were recognized by them as being well shown.

Prof. J. F. Kemp, in his report on the geology of Essex County, N. Y.,[‡] gives a geologic map of Crown Point township, in which he represents the greater portion of the peninsula as underlaid by the Chazy, with the Trenton at the extreme point. He mentions the locality as a good one for studying the older Paleozoics, as all the formations from the Potsdam to the base of the Utica slate are represented.

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[*] Bull. Geol. Soc. Am., vol. 2, p. 300, 1891.

[†] Bull. Am. Mus. Nat. Hist., vol. 8, p. 305, 1896.

[‡] Report of the State Geologist, 1893.

In his paper on the Upper Ordivician faunas of the Champlain Valley* (1899) Theo. G. White gives a short notice of this section. The thickness of the Black River limestone he states as 71 feet, 3 inches, and of the Trenton 100 feet.

---

*Bull. Geol. Soc. Am., 1899.

SECTIONS

As a continuous exposure of the rocks could not be had in any one line, three sections were made. The measurements were made with tape, hand level, and by plotting on the map.

Section A

Section A begins with the top layers of the Calciferous and runs for about a thousand feet along the east shore of Bulwagga Bay. The strike here is N. 30° E.

In ascending order the measures were:

A 1. Light gray, pure, dolometic limestone in two heavy beds whose surfaces were uneven and worn into humps and depressions. Probably Calciferous. 3 ft. 3 in.

2. Thick beds of slaty shale, with occasional bands of hard, fine-grained, sparkling limestone. The latter layers contain numerous fragments of *Lingula brainerdi* sp. nov. Their surfaces are covered with an undetermined species of fucoid. Pyrite is very abundant. 12 ft. 7 in. 12 ft. 7 in.

3. Heavy bedded, impure gray limestone, weathering to a rough, sandy appearance. No fossils. 5 ft. 0 in. 17 ft. 7 in.

4. Heavy bedded limestones, interstratified with slaty shale. No fossils other than the numerous fucoids. 7 ft. 7 in. 25 ft. 2 in.

5. Two heavy beds of light gray, coarsely crystalline, impure limestone, containing few fossils. 3 ft. 4 in. 28 ft. 6 in.

*r *Camarella varians.*
r *Dinorthis platys.*

6. Thin bedded, impure, nodular, blue limestone. Some layers contain many fossils. 3 ft. 4 in. 31 ft. 10 in.

r *Maclurea magna.*
r *Hebertella borealis.*
c *Dinorthis platys.*
r *Orthis costalis.*
c *Rafinisquina fasciata.*
r *R. champlainensis.*
c *Asaphus canalis.*

7. Thin bedded, impure limestone, interstratified with coarsely crystalline, impure layers containing many crinoid stems. Fossils rare. At base *Dinorthis platys* was common and *Asaphus canalis* rare. At top we found:

r *Maclurea magna.*
r *Camarella varians.*
c *Leperditia canadensis* var. *nana.*
c *Orthis* (?) *porcia.*
r *Asaphus canalis.*
7 ft. 10 in. 39 ft. 8 in.

8. Impure, heavy bedded, bluish limestones containing many fossils, which, however, it is difficult to extract. 12 ft. 3 in. 51 ft. 11 in.

r *Orthis* (?) *porcia.*
c *Rafinisquina champlainensis.*
rr *Triplecia gracilis.*
r *Hebertella borealis.*
r *Dinorthis deflecta* (?).
r *Asaphus canalis.*

From this point the rocks are covered for about a thousand feet along the shore. Then we find impure, bluish limestones in which *Maclurea magna* is very common.

At A 8 the directions of the joint planes are N. 50° E., N. 35° W., and N. & S. Glacial striæ, N. 34° E.

---

*The small letter before each name signifies abundance: c means common, a abundant, aa, that the rock is filled with individuals of that species; r denotes rare and rr that only one or two specimens were found.

SECTION B.

Section B begins on the point directly north of the lighthouse and follows the shore westward to the beginning of a sandy beach just beyond the covered entrance of old Fort St. Frederick. All the rock exposed is Chazy limestone.

B 1. One foot of sandy, non-fossiliferous limestone. 1 ft. 1 ft. 0 in.

2. Impure, thin bedded, nodular limestone. No fossils. 8 ft. 3 in. 9 ft. 3 in.

3. Heavy bedded, much jointed, impure, gray limestone. 4 ft. 13 ft. 3 in.

r *Rafinisquina fasciata.*
rr *Ctenodonta levata.*
rr *Raphistoma stamineum.*
r *Asaphus canalis.*
c *Leperditia amygdalina.*
c *Dinorthis deflecta* (?)
r *Maclurea magna.*
rr *Raphistoma planistria* var. *parvum.*
r Crinoid stems.

4. Impure, very fossiliferous, fine-grained, thin bedded limestone with good joints N. 75° E. and N. 20° E. 3 ft. 3 in. 16 ft. 6 in.

c *Bucania champlainensis.*
rr *B. sulcatina.*
rr *Raphistoma stamineum.*
rr *R. striatum.*
c *Rafinisquina champlainensis.*
r *R. alternata.*
rr *R. fasciata.*
a *Dinorthis deflecta* (?)
rr *Camarella varians.*
r *Asaphus canalis.*
rr *Illænus arcturus.*
c *Leperditia amygdalina.*
r *Streptolasma expansum.*

In this zone the operculum of *Maclurea magna* was found rather commonly.

5. Covered by bay and sandy beach to the point on which the ferry lands. 42 ft. 58 ft. 6 in.

6. Light gray, sparkling, fine-grained limestone, much broken and jointed. The principal

joints are N. 78° W., N. 42° E. and N. 47° W. Few fossils. 8 ft. 6 in. 67 ft. 0 in.

r *Maclurea magna.*
c *Asaphus canalis.*
r *Orthoceras* sp. und.
r *Camarella* sp. und.
c *Leperditia canadensis* var. *nana.*

7. Impure, nodular, bluish limestone containing few fossils. 4 ft. 2 in. 71 ft. 2 in.

c *Maclurea magna.*
r *Triplecia gracilis.*
rr *Illænus arcturus.*
rr *Ecculiomphalus fredericus.*

8. Fairly pure, thin bedded, gray layers. 1 ft. 6 in. 72 ft. 8 in.

rr *Rafinisquina robusta.*
c *Dinorthis deflecta* (?).
r *Dalmanella* (?) *plicifera.*
r *Camarella varians.*
r *Maclurea magna.*
c *Leperditia amygdalina.*
c *Leperditia canadensis* var. *nana.*
r *Primita logani.*
r *Asaphus canalis.*

9. Impure, thin bedded, shaly limestones, alternating with thicker, pure layers. 6 ft. 6 in. 79 ft. 2 in.

rr *Ctenodonta levata.*
c *Maclurea magna.*
rr *Raphistoma striatum.*
rr *Illænus ovatus.*
rr *Asaphus canalis.*
rr *Murchisonia* sp. und.
c *Streptolasma expansum.*
c *Dinorthis deflecta* (?)
c *Camarella longirostris.*
c *Bucania champlainensis.*
rr *Leperditia canadensis* var. *nana.*

10. Fine grained, dark gray, thin bedded limestones, sparkling when fractured. Very fossiliferous. It is the best collecting place for brachiopods on the Point. Well exposed about one hundred feet west of the ferry landing. Marked F on the map. 5 ft. 4 in. 84 ft. 6 in.

r *Maclurea magna.*
r *Raphistoma planistria* var. *parvum.*
r *Pleurotomaria* sp. und.
r *Murchisonia perangulata.*
rr *Bucania bidorsata* (?).
r *Rafinisquina alternata.*
rr *R. fasciata.*
c *R. champlainensis.*
a *Dinorthis deflecta* (?).
r *Camarella longirostris.*
r *C. varians.*
r *Asaphus canalis.*
rr *Illænus ovatus.*
rr *Calymene* sp. und.
r *Leperditia canadensis* var. *nana.*
rr *Stictopora elegantula* (?).

11. Thick bedded, rather pure, gray limestone exposed just west of entrance to the old French fort. 4 ft. 2 in. 88 ft. 8 in.

r *Maclurea magna.*
a *Dinorthis deflecta* (?).
c *Asaphus canalis.*
rr *Illænus ovatus.*
r *Leperditia canadensis* var. *nana.*
c *Dalmanella* (?) *plicifera.*
r *Rafinisquina champlainensis.*
r *Camarella varians.*
r *Triplecia gracilis.*

12. Fine grained, gray, sparkling layers in heavy beds. No fossils. 2 ft. 8 in. 91 ft. 4 in.

13. Dark gray, thin bedded, pure limestone which weathers so as to show bands about an inch in width. Bottom foot shaly. Fossils not common. The *Rafinisquinas* found here are a small but strongly marked variety, never exceeding three-eighths of an inch in width. This variety occurs also in C 10, where it is again associated with *Camarella longirostris*, *C. varians* and *Triplecia gracilis*, which are the most common species of the two zones. 5 ft. 96 ft. 4 in.

rr *Ctenodonta nasuta.*
rr *Metoptoma dubia.*
r *Triplecia gracilis.*
a *Camarella longirostris.*
a *C. varians.*
a *Rafinisquina alternata.*
a *Asaphus canalis.*
r *A. obtusus.*
rr *Bathyurellus validus.*

14. Heavy bedded, pure limestone, containing some veins of calcite. Very hard. Bluish gray in color. Forms the top layers of the small cliff in front of Ft. St. Frederick. Except for one cephalon of *Asaphus canalis*, no fossils were found. 7 ft. 6 in. 103 ft. 10 in.

15. Heavy bedded, light colored magnesian limestone which weathers on a vertical surface in ridges about an inch apart. Well shown at the once secret entrance to the old fort. 7 ft. 3 in. 111 ft. 1 in.

rr *Camarella longirostris.*
rr *Dalmanella testudinaria.*
rr *D.* (?) *plicifera.*
r *Triplecia gracilis.*
r *Asaphus platycephalus.*
c *A. canalis.*
c *Asaphus obtusus.*
r *Illænus ovatus.*
c *Leperditia canadensis* var. *nana.*
r *Primita logani.*

16. Lithological character same as 15, but carrying fewer fossils. 5 ft. 116 ft. 1 in.

rr *Rafinisquina alternata.*
c *Asaphus canalis.*
c *Camarella varians.*

17. Covered along a sandy beach to the middle layers of the Black River limestone. The top of No. 16 is 40 ft. below the base of the Black River limestone.

SECTION C

Section C extends from the road at a point about one-half mile south of the light house across the fields through the old English fort, then from the northern entrance of the fort northwest to the shore beyond the old "marble quarry". Thence it follows the shore where there is an almost continuous exposure of the strata around to the northwestern corner of the Point. The middle and upper Chazy, all the Black River, and the lower 90 feet of the Trenton are shown.

C 1. Heavy bedded layers, largely made up of sand grains cemented by lime. Exposed in a ridge running N. E. and S. W. 8 ft. 2 in. 8 ft. 2 in.

r *Maclurea magna.*
rr *Orthis hippolite.*
rr *Rhynchonella* (?) *acutirostris.*
rr *Camarella varians.*
c *Asaphus canalis.*
c *Leperditia canadensis* var. *nana.*
r *Leperditia amygdalina.*

2. Covered across a nearly level field. 82 ft. 90 ft. 2 in.

3. Bottom foot a very hard, dark gray, fine grained, rather pure limestone containing no fossils. Above this, 6 ft. 2 in. of impure, very fossiliferous, shaly limestone. 7 ft. 2 in. 97 ft. 4 in.

c *Maclurea magna.*
rr *Ecculiomphalus fredericus.*
c *Dinorthis deflecta* (?).
r *Rafinisquina champlainensis.*
r *Rafinisquina fasciata.*
rr *Camarella longirostris.*
c *Asaphus canalis.*
r *Leperditia amygdalina.*

4. Thin, impure, evenly bedded layers on west side of a small ridge parallel to C 1. 7 ft. 3 in. 104 ft. 7 in.

c *Maclurea magna.*
rr *Camarella longirostris.*
c *Dinorthis deflecta* (?).
rr *Illænus ovatus.*
rr *Asaphus canalis.*
rr *Leperditia amygdalina.*

5. One layer of hard, fine grained, dark gray limestone with no recognizable fossils beyond *Leperditia canadensis* var. *nana* and a few fragments of a trilobite. The dip on the surface of this layer is 7° 20′ N. 59° W. 2 ft. 3 in. 106 ft. 10 in.

6. Impure, shaly, somewhat nodular and irregularly bedded layers with fucoid markings, forming the top layers of the ridge a few yards southeast of the pavilion. One of the best collecting places for trilobites and gastropods. 5 ft. 3 in. 112 ft. 1 in.

rr *Ctenodonta levata.*
c *Maclurea magna.*
rr *Pleurotomaria* sp. und.
r *Raphistoma striatum.*
rr *Cyrtolites* cf. *trentonensis.*
rr *Murchisonia perangulata.*
rr *Ecculiomphalus fredericus.*
r *Rafinisquina champlainensis.*
r *R. alternata.*
c *Dinorthis deflecta* (?).
c *Asaphus canalis.*
r *Illænus ovatus.*
r *I. arcturus.*
r *Leperditia canadensis* var. *nana.*
c *Monticulipora lycoperdon.*
c *Palaeocistites tenuiradiatus.*
rr *Lituites* sp. und.

7. Hard, fine grained, bluish limestone. 3 ft. 10 in. 115 ft. 11 in.

rr *Ecculiomphalus fredericus.*
c *Maclurea magna.*
c *Raphistoma stamineum.*
r *R. planistria* var. *parvum.*
rr *Camarella varians.*
c *Dinorthis deflecta* (?).
c *Asaphus canalis.*
r *Illænus ovatus.*
r *Streptolasma expansum.*
rr *Orthoceras tenuiseptum.*

8. Covered. 4 ft. 119 ft. 11 in.

9. Hard, heavy bedded, bluish gray, non-fossiliferous limestone lying north of the pavilion. 6 ft. 125 ft. 11 in.

10. Quite impure, shaly, light gray limestone between the pavilion and the edge of the debris piled up east of the English fort. 12 ft. 3 in. 138 ft. 2 in.

rr *Ambonychia mytiloides.*
rr *Metoptoma montrealensis.*
r *M. dubia.*
r *Pleurotomaria* sp. und.
c *Rafinisquina alternata.**
r *Dinorthis deflecta* (?).
r *Dalmanella* (?) *plicifera.*
c *Triplecia gracilis.*
r *Camarella varians.*
c *C. longirostris.*
c *Asaphus canalis.*
r *A. marginalis.*
r *A.* sp.
c *Leperditia canadensis* var. *nana.*

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*See Zone 13, Section B.

11. Covered. 25 ft. 163 ft. 2 in.

12. Layers in bottom of trench at northeastern angle of fort. Pure, thin bedded magnesian limestone. Very fossiliferous. 8 ft. 5 in. 171 ft. 7 in.

c *Maclurea magna.*
rr *Raphistoma stamineum.*
a *R. planistria* var. *parvum.*
r *Murchisonia* sp. und.
r *Pleurotomaria* sp. und.
rr *Metoptoma montrealensis.*
rr *Lituites undatus.*
r *Camarella varians.*
r *C. longirostris.*
r *Triplecia gracilis.*
rr *Dalmanella* (?) *plicifera.*
c *Dinorthis deflecta* (?).
a *Asaphus canalis.*
r *A. marginalis.*
rr *A. obtusus.*
r *Leperditia canadensis* var. *nana.*
c *Palaeocistites tenuiradiatus.*

13. Dark gray, very heavy bedded magnesian limestone weathering in alternating light and dark bands an inch wide. Contains a few specimens of *Maclurea magna.* 17 ft. 3 in. 188 ft. 10 in.

14. Very hard, bluish gray magnesian limestone in heavy beds. No fossils. 7 ft. 2 in. 196 ft.

15. One layer of coarse grained sandstone in which there are many holes, as though fossils had been dissolved out. Forms the floor of the western part of the parade ground inside the fort. 2 ft. 198 ft.

16. Hard magnesian limestone containing many large water worn sand grains. 1 ft. 199 ft.

r *Raphistoma stamineum.*
r *Camarella varians.*
Top of the Chazy.
r *Dinorthis deflecta* (?).
c *Asaphus canalis.*

17. Covered to bottom of ledge just across the road from the north entrance to the fort. 20 ft. 219 ft.

18. Rather thick layers (6–12 inches) of dove colored, pure limestone having a conchoidal fracture. The middle two feet are almost black, but the top and bottom of the zone are of the characteristic color and pureness of the "Birdseye" limestone of the Mohawk Valley. "Birdseyes" are common throughout the five feet. 5 ft. 224 ft.

r *Holopea* sp. und.
r *Murchisonia* sp. und.
r *Zygospira recurvirostris.*
r *Leperditia fabulites.*
c *Phytopsis tubulosus.*

19. Fairly pure, heavy bedded, fine grained, dark gray limestone with conchoidal fracture. 7 ft. 231 ft.

rr *Whitella ventricosa.*
r *Ctenodonta nasuta.*
r *Cuneamya subtruncata.*
c *Ctenodonta levata.*
r *Maclurea logani.*
rr *Murchisonia gracilis.*
c *M. milleri.*
r *Pleurotomaria subconica.*
c *Endoceras* sp. und.
r *Rafinisquina alternata.*
r *Strophomena incurvata.*
c *Plectorthis plicatella.*
r *Asaphus platycephalus.*
r *Ceraurus pleurexanthemus.*
c *Leperditia fabulites.*
c *L. canadensis* var. *nana.*
rr *Primita logani.*
c *Monticulipora lycoperdon.*
c *Streptolasma corniculum.*

20. Impure, light gray, coarse grained, heavy bedded limestone containing many fossils. Top layers of the ledge. In the upper layers of this zone is a very large specimen of *Columnaria alveolata.* 2 ft. 6 in. 233 ft. 6 in.

rr *Ctenodonta nasuta.*
r *Murchisonia milleri*
r *Fusispira subfusiformis.*
r *Endoceras* sp. und.
c *Asaphus platycephalus.*
r *Illænus arcturus.*
r *I. americanus.*

c *Dalmanella subæquata* var. *pervetus.*
r *Plectorthis plicatella.*
r *Rafinisquina alternata.*
r *Rhynchotrema inæquivalve.*
c *Zygospira recurvirostris.*
c *Columnaria alveolata.*
r *Stictopora elegantula.*
r *Bathyurus spiniger.*
r *Leperditia canadensis* var. *nana.*
c *Leperditia fabulites.*
c *Streptolasma corniculum.*
c *Monticulipora lycoperdon.*

21. Impure, dark gray limestone containing much chert. This zone is capped by a two inch layer of chert which has been polished by the action of the ice, glacial striæ showing upon it. This is probably the layer spoken of by Prof. Emmons. (See historical sketch.) 5 ft. 6 in. 239 ft.

c *Strophomena incurvata.*
r *Zygospira recurvirostris.*
r *Asaphus platycephalus.*
r *Leperditia fabulites.*
r *Leperditia canadensis* var. *nana.*
r *Stromatocerium rogosum.*
r *Columnaria alveolata.*

22. Covered. 4 ft. 243 ft.

23. Impure, light gray, coarse grained limestone containing nodules of chert. 6 ft. 8 in. 249 ft. 8 in.

c *Cuneamya subtruncata.*
rr *Murchisonia gracilis.*
rr *M. milleri.*
c *Rafinisquina alternata.*
r *Rhynchotrema inæquivalve.*
c *Strophomena incurvata.*
r *Plectorthis plicatella.*
r *Asaphus platycephalus.*
r *Streptolasma corniculum.*
rr *Illænus arcturus.*
rr *Dalmanites callicephalus.*
rr *D. eboraceus.*
c *Leperditia fabulites.*
c *Stromatocerium rogosum.*
c *Columnaria alveolata.*
r *Monticulipora lycoperdon.*

24. Impure, light colored, coarse grained layers grading into a black, fine grained limestone with conchoidal fracture. Contains some chert. 6 ft. 2 in. 255 ft. 10 in.

r *Murchisonia milleri.*
rr *Raphistoma* sp. und.
c *Endoceras* sp. und.
c *Rafinisquina alternata.*
a *Strophomena incurvata.*
rr *Dalmanella testudinaria.*
a *Zygospira recurvirostris.*
c *Rhynchotrema inæquivalve.*
rr *Dinorthis pectinella.*
c *Plectorthis plicatella.*
c *Stictopora elegantula.*
c *Stromatocerium rogosum.*
a *Monticulipora lycoperdon.*
a *Leperditia fabulites.*
a *L. canadensis* var. *nana.*
c *Asaphus platycephalus.*
a *Dalmanites callicephalus.*
c *D. eboraceus.*
rr *Illænus arcturus.*
r *Bathyurus spiniger.*
c *Ceraurus pleurexanthemus.*
c *Streptolasma corniculum.*

25. Heavy bedded, black, fine grained limestone with conchoidal fracture, passing into a coarser magnesian limestone. Forms the top layers of the old black marble quarry. 6 ft. 7 in. 262 ft. 5 in.

r *Ctenodonta nasuta.*
r *C. levata.*
rr *Raphistoma lenticulare.*
r *Murchisonia milleri.*
c *Asaphus platycephalus.*
c *Strophomena incurvata.*
c *Zygospira recurvirostris.*
r *Stromatocerium rogosum.*

26. Dark, bluish gray, heavy bedded, impure limestone containing few fossils. 6 ft. 9 in. 269 ft. 2 in.

rr *Maclurea* cf. *affinis.*
r *Ctenodonta levata.*
r *Strophomena incurvata.*
r *Illænus americanus.*
c *Monticulipora lycoperdon.*

27. Hard, dark gray, quite pure limestone along the shore west of the rubble dock. 14 ft. 10 in. 284 ft.

rr *Ctenodonta levata.*
r *Maclurea logani.*
r *Glossina trentonensis.*
c *Rafinisquina alternata.*
rr *Strophomena incurvata.*
r *Dinorthis pectinella.*
c *Triplecia extans.*
r *Asaphus platycephalus.*
r *Leperditia canadensis* var. *nana.*
c *Stromatocerium rogosum.*
r *Monticulipora lycoperdon.*
c *Columnaria alveolata.*

28. Very impure, coarse grained, soft, crumbly limestone. 2 ft. 286 ft.

c *Maclurea logani.*
r *Dalmanella testudinaria.*
c *Strophomena incurvata.*
c *Asaphus platycephalus.*

29. Covered along a stony beach. 4 ft. 290 ft.

30. Black, rather pure layers of limestone with shaly partings. Base of the Trenton. 4 ft. 9 in. 294 ft. 9 in.

r *Endoceras protiforme.*
a *Raphistoma lenticulare.*
c *Bellerophon bilobatus.*
r *Subulites elongata.*
rr *Ctenodonta levata.*
r *Triplecia extans.*
rr *Rhynchotrema inæquivalve.*
r *Asaphus platycephalus.*

31. A lighter colored, hard, pure limestone in layers about five inches thick. 6 ft. 3 in. 301 ft.

r *Endoceras protiforme.*
r *Dalmanella testudinaria.*
c *Plectambonites sericeus.*
rr *Parastrophia hemiplicata.*
rr *Calymene senaria.*
r *Ceraurus pleurexanthemus.*

32. Calcareous layers like the preceding but interbedded with much shale. 4 ft. 6 in. 305 ft. 6 in.

r *Bellerophon bilobatus.*
r *Murchisonia milleri.*
r *Whitella ventricosa.*
c *Ctenodonta levata.*
c *Dalmanella testudinaria.*
a *Plectambonites sericeus.*
r *Rafinisquina alternata.*
r *Dinorthis pectinella.*
r *Calymene senaria.*
r *Illænus ovatus.*
r *Monticulipora lycoperdon.*

33. Thick, alternating layers of shale and pure limestone covered for the most part by fragments of the underlying rock. 5 ft. 310 ft. 6 in.

r *Orthoceras* sp. und.
rr *Bucania* sp. und.
aa *Dalmanella testudinaria.*
a *Orthis tricenaria.*
aa *Plectambonites sericeus.*
r *Rafinisquina alternata.*
r *Parastrophia hemiplicata.*
r *Calymene senaria.*
r *Asaphus platycephalus.*

34. Thin bedded, fine grained limestone with many shaly layers. 5 ft. 315 ft. 6 in.

c *Dalmanella testudinaria.*
c *Plectambonites sericeus.*
r *Rafinisquina alternata.*
r *Parastrophia hemiplicata.*

35. Hard, fine grained, bluish layers interstratified with which are three beds of shale, each about six inches in thickness. 4 ft. 11 in. 220 ft. 5 in.

aa *Dalmanella testudinaria.*
c *Plectambonites sericeus.*
c *Rafinisquina alternata.*
c *Asaphus platycephalus.*
r *Calymene senaria.*
r *Ceraurus pleurexanthemus.*

36. Hard, gray, crystalline limestone. 4 ft. 5 in. 224 ft. 10 in.

r *Orthoceras* sp. und.
r *Bellerophon bilobatus.*
rr *Lingula* sp. und.
c *Dalmanella testudinaria.*
aa *Plectambonites sericeus.*
rr *Encrinurus vigilans.*
c *Asaphus platycephalus.*

37. Gray, very fossiliferous layers. 6 ft. 8 in. 231 ft. 6 in.

rr *Orthoceras* sp. und.
r *Bellerophon bilobatus.*
rr *Bucania punctifrons.*
a *Dalmanella testudinaria.*
r *Rafinisquina alternata.*
r *Dalmanites callicephalus.*
c *Plectambonites sericeus.*
r *Asaphus platycephalus.*
rr *Encrinurus vigilans.*
r *Calymene senaria.*

38. Character much the same as the preceding, but darker in color. 4 ft. 2 in. 235 ft. 8 in.

rr *Lingula curta.*
c *Plectambonites sericeus.*
rr *Dalmanella testudinaria.*
r *Monticulipora lycoperdon.*
a *Rafinisquina alternata.*
r *Asaphus platycephalus.*

39. Compact, dark gray, very fossiliferous limestone with little shale. 5 ft. 240 ft. 8 in.

rr *Raphistoma lenticulare.*
c *Bellerophon bilobatus.*
c *Bucania punctifrons.*
rr *Holopea paludiniformis.*
rr *Conularia trentonensis.*
c *Dalmanella testudinaria.*
c *Rafinisquina alternata.*
r *Parastrophia hemiplicata.*
rr *Encrinurus vigilans.*
rr *Monticulipora lycoperdon.*
c *Plectambonites sericeus.*
c *Ceraurus pleurexanthemus.*
c *Dalmanites callicephalus.*
r *Calymene senaria.*
r *Trinucleus concentricus.*
rr *Asaphus platycephalus.*

40. Fine grained, bluish limestone in thin beds, interstratified with shaly layers which are packed with brachiopods. 4 ft. 244 ft. 8 in.

rr *Cuneamya subtruncata.*
rr *Modiolopsis* sp. und.
rr *Pleurotomaria* sp. und.
aa *Dalmanella testudinaria.*
c *Plectambonites sericeus.*
c *Monticulipora lycoperdon.*
rr *Rafinisquina alternata.*
rr *Platystrophia biforata.*
r *Asaphus platycephalus.*
r *Trinucleus concentricus.*

41. Compact limestone with an occasional thin layer of shale. 6 ft. 6 in. 251 ft. 2 in.

c *Bellerophon bilobatus.*
aa *Dalmanella testudinaria.*
aa *Plectambonites sericeus.*
r *Calymene senaria.*
c *Asaphus platycephalus.*
rr *Trinucleus concentricus.*

42. Coarse grained limestone grading into a very fossiliferous shale at the top. 5 ft. 256 ft. 2 in.

rr *Bucania punctifrons.*
a *Dalmanella testudinaria.*
c *Plectambonites sericeus.*
c *Platystrophia biforata.*
c *Monticulipora lycoperdon.*
r *Asaphus platycephalus.*
r *Trinucleus concentricus.*
rr *Calymene senaria.*

43. Thin bedded limestone and a great many thick, shaly layers. 4 ft. 1 in. 260 ft. 3 in.

c *Dalmanella testudinaria.*
a *Plectambonites sericeus.*
c *Platystrophia biforata.*
r *Asaphus platycephalus.*
r *Dalmanites callicephalus.*
c *Trinucleus concentricus.*
c *Monticulipora lycoperdon.*

44. Mostly covered, one shaly layer only being exposed. 4 ft. 10 in. 265 ft. 1 in.

rr *Oncoceras constrictum.*
c *Dalmanella testudinaria.*
c *Rafinisquina alternata.*
r *Dalmanites callicephalus.*
a *Plectambonites sericeus.*
r *Asaphus platycephalus.*

45. Hard, compact gray limestone. 5 ft. 270 ft. 1 in.

rr *Trocholites ammonius.*
rr *Cyprocardites* sp. und.
r *Ctenodonta nasuta.*
r *Bellerophon bilobatus.*
r *Trematis terminalis.*
c *Dalmanella testudinaria.*
r *Rafinisquina alternata.*
r *Dalmanites callicephalus.*
c *Monticulipora lycoperdon.*
aa *Plectambonites sericeus.*
c *Platystrophia biforata.*
c *Asaphus platycephalus.*
r *Calymene senaria.*
rr *Pylloporina reticulata.*

46. Hard, coarse grained, crystalline limestone with shaly partings. 4 ft. 9 in. 274 ft. 10 in.

c *Orthoceras* sp. und.
r *Bellerophon bilobatus.*
r *Lingula rectilateralis.*
a *Rafinisquina alternata.*
a *Plectambonites sericeus.*
aa *Platystrophia biforata.*
r *Ceraurus pleurexanthemus.*
r *Trinucleus concentricus.*
c *Calymene senaria.*
r *Dalmanites callicephalus.*
c *Asaphus platycephalus.*

47. Very like 46, but in thinner beds. 3 ft. 277 ft. 10 in.

r *Orthoceras* sp. und.
rr *Cyrtolites trentonensis.*
c *Bellerophon bilobatus.*
r *Lingula rectilateralis.*
c *Rafinisquina alternata.*
r *Plectambonites sericeus.*
r *Dalmanites callicephalus.*
c *Platystrophia biforata.*
aa *Asaphus platycephalus.*
r *Calymene senaria.*
c *Trinucleus concentricus.*

CORRELATION AND CONCLUSIONS

From the measurements it will be seen that B 6, 7, 8, 9 correspond to C 9 and 10. B 14, 15, 16 are the same layers as C 12 and the lower 7 feet of C 13. The gap at B 5 is filled by C 3 to 8; and B 10 to 13 exhibits the strata covered by the rubbish east of the fort (C 11). All of section A is below the base of C.

The Chazy in this section is not capable of the same subdivisions as at Valcour Island and elsewhere to the northward. At the base there is a well-marked zone of shale and hard magnesian limestone, 25 feet in thickness, containing *Lingula brainerdi* and fucoids in abundance. This zone is also well shown at Valcour Island, where it is 26 feet thick with the base not shown. There, in addition to the numerous *Lingulæ*, it contains other fossils.

Above this zone, the measures consist of more or less impure limestones, usually thin bedded and often shaly. *Maclurea magna*, *Rafinisquina champlainensis*, *Dinorthis deflecta* (?), *Camarella varians* and *Asaphus canalis* are found almost everywhere in these strata except for a few feet near the top. *Camarotœchia plena* Hall, which is so abundant in the upper part of the more northern sections, is not found here. *Raphistoma planistria* var. *parvum* Hall, which, by its abundance, characterizes a zone in the upper part of the mass at Crown Point, is also abundant in a zone about 90 feet below the top at Valcour Island. However, the accompanying fauna is quite different. The species provisionally identified as *Dinorthis deflecta* Conrad occurs abundantly in many localities, but is almost always partially exfoliated or in casts. More perfectly preserved specimens are needed to make sure its specific identification.

As would be expected from the nature of the sediments, pelecypods are almost entirely wanting.

The Birdseye limestone in this section is a lighter colored, purer subdivision of the Black River, grading gradually into it. The latter can here be subdivided into faunal zones, which might be named from the class of fossils which is most abundant in them. At the base is the Birdseye zone, 5 feet in thickness, characterized by *Phytopsis tubulosus* Hall and *Leperditia fabulites* Conrad. Above it, the Pelecypod zone, 7 feet in thickness, contains an abundance of lamellibranchs of the genera *Ctenodonta*, *Cuneamya* and *Whitella*. The remainder can be put into one zone, 55 feet in thickness, in which both the brachiopoda and crustacea are common, the latter being more prominent in the lower 30 feet and the brachiopoda in the upper part.

There seems to be a direct connection between the lithological characters of these zones and the fossil contents. The first is a very pure, light colored, fine grained limestone; the second, pure, lumpy, black and heavy bedded; the third, impure, coarse, light gray and rather crystalline in the lower part, becoming finer grained, but still impure, toward the top.

The fossils which at this locality occur commonly in the Black River, and in none of the other formations, are: *Maclurea logani* Salter, *Plectorthis plicatella* Hall, *Strophomena incurvata* Shepard, *Zygospira recurvirostris* Hall, *Stromatocerium rogosum* Hall, *Columnaria alveolata* Goldfuss, and *Leperditia fabulites* Conrad. The abundance of *Rhynchotrema inæquivalve* Castelnau, *Ceraurus pleurexanthemus* Green, and *Dalmanites callicephalus* Hall is a feature of these limestones at many localities and is well illustrated in this section. Only the branching form of *Monticulipora lycoperdon* Say occurs below the Trenton, thus agreeing with the statement of E. R. Cummings* regarding the same fossil in the Mohawk valley. He found the hemispheric form above the Black River only.

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*Lower Silurian Sections. Bull. N. Y. State Museum, No. 34. Albany, 1900.

The lowest member of the Trenton in this section is the *Raphistoma lenticulare* zone, 4 feet 9 inches in thickness. This fossil is common in this zone, but only one specimen was found above.*

Above this is the *Parastrophia hemiplicata* zone of Theo. G. White†. Although not abundant, this fossil is characteristic of 20 feet 9 inches (C 31–34). C 39–43 are marked by the presence of *Trinucleus concentricus* Eaton, which is not found lower in the strata. It will be seen that trilobites are a much more prominent part of the fauna after C 37. *Asaphus platycephalus* Stokes, which has not before been common, becomes abundant in C 46 and 47.

Dalmanella testudinaria, *Rafinisquina alternata*, *Plectambonites sericeus*, *Bellerophon bilobatus*, *Asaphus platycephalus*, and *Calymene senaria* are found all through the Trenton here, as at the type locality, Trenton Falls, N. Y. *Platystrophia biforata* is not found in the lowest part, either in this section or at Trenton Falls. Lamellibranchs are not common at either place.

LIST OF SPECIES

A 1–8. Basal 52 feet of Chazy.
B 1–16. Upper 146 feet of Chazy.
C 1–17. Upper 219 feet of Chazy.
C 18–29. Black River. 67 feet.
C 30–47. Trenton limestone. Lower 88 feet.

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*Since the Trenton at Crane's Point and Norton's Bay on the Vermont side of the lake, about two miles distant, is 314 feet in thickness, the strata shown on this Point represent less than one-third of a complete section.

†Trans. N. Y. Acad. Sci., XXV, p. 20 (1895).

PLANTÆ (?)

Phytopsis tubulosus Hall. C 18.

CŒLENTERATA.

Monticulipora lycoperdon Say.
  Ramose form. C 6, 19, 20, 23, 24, 26, 27.
  Both ramose and hemispheric forms. C 32, 38, 39, 40, 43.
Streptolasma expansum Hall. B 4, 9. C 7.
S. corniculum Hall. C 19, 20, 23.
Columnaria alveolata Goldfuss. C 20, 21, 23, 27.
Stromatocerium rogosum Hall. C 21, 23, 24, 25, 27.

ECHINODERMATA.

Palæocistites tenuiradiatus Hall. C 6, 12.

MOLLUSCOIDEA.

1. Bryazoa.

Stictopora elegantula Hall. C 10 (?), 20, 24.
Pylloporina reticulata Hall. C 45.

2. Brachiopoda.

Lingula brainerdi n. sp. A 2.
L. curta Conrad. C 38.
L. rectilateralis Emmons. C 46, 47.
Glossina trentonensis Conrad. C 27.
Trematis terminalis Emmons. C 45.
Rafinisquina alternata Emmons. A 6. B 4, 10, 13, 16. C 6, 10, 19, 20, 23, 24, 27, 32–35, 38–40, 44–47.
R. fasciata Hall. A 6. B 3, 4, 10. C 3.
R. champlainensis n. sp. A 8. B 4, 8, 10, 11. C 3, 6.
Strophomena incurvata Shepard. C 19, 21, 23–28.
Plectambonites sericeus Sowerby. C 31, 36, 38–47.
Triplecia gracilis n. sp. A 8. B 7, 11, 13, 15. C 12.
T. extans Emmons. C 27, 30.
Orthis costalis Hall. A 6.
O. hippolyte Billings. C 1.

O. (?) porcia Billings. A 7, 8. C 1.
O. tricenaria Conrad. C 33.
Plectorthis plicatella Hall. C 19, 20, 23, 24.
Dinorthis deflecta (?) Conrad. A 8. B 3, 4, 8–11. C 3, 4, 6, 7, 10, 12, 16.
D. pectinella Emmons. C 24, 27.
D. platys Billings. A 5, 6, 7.
Hebertella borealis Billings. A 6, 8.
Platystrophia biforata Schlotheim. C 40, 42, 43, 45–47.
Dalmanella (?) plicifera Hall. B 8, 11, 15. C 10, 12.
D. subæquata pervetus Conrad. C 20.
D. testudinaria Dalman. B 15. C 24, 28, 32–47.
Camarella longirostris Billings. B 9, 10, 13, 15. C 3, 4, 10, 12.
C. varians Billings. A 5, 7. B 5, 10, 12, 13, 15, 17. C 1, 7, 10, 12, 16.
Parastrophia hemiplicata Hall. C 31, 33, 34, 39.
Rhynchotrema inæquivalve Castelnau. C 20, 23, 24.
Rhynchonella (?) acutirostris Hall. C 1.
Zygospira recurvirostris Hall. B 18, 20, 21, 24, 25.

MOLLUSCA.

1. Pelecypoda.

Ctenodonta levata Hall. B 3, 9. C 6, 19, 25–27, 30, 32.
C. nasuta Hall. B 13. C 19, 20, 25, 45.
Whitella ventricosa Hall. C 19, 32.
Cuneamya subtruncata Hall. C 19, 23.
Ambonychia mytiloides Hall. C 10.

2. Gastropoda.

Raphistoma lenticulare Emmons. C 25, 30, 39.
R. planistria var. parvum Hall. B 3, 10. C 7, 12.
R. stamineum Hall. B 3, 4. C 12, 16.
R. striatum Emmons. B 4, 9. C 6, 7.
Holopea paludiniformis Hall. C 39.
Ecculiomphalus fredericus n. sp. B 7. C 3, 6, 7.

Metoptoma dubia Hall. B 13. C 10.
M. montrealensis Billings. C 10, 12.
Subulites elongatus Emmons. C 30.
Maclurea magna Le Sueur. A 6, 7. B 3, 6–11. C 1, 3, 4, 6, 7, 12, 13.
M. logani Salter. C 19, 27, 28.
Murchisonia gracilis Hall. C 19, 23.
M. milleri Hall. C 19, 20, 23–26.
M. perangulata Hall. B 10. C 6.
Fusispira subfusiformis Hall. C 20.
Pleurotomaria subconica Hall. C 19.
Bellerophon bilobatus Sowerby. C 30, 32, 36, 37, 39, 41, 45–47.
Bucania champlainensis Whitfield. B 4, 9.
B. punctifrons Emmons. C 37, 39, 42.
B. sulcatina Emmons. B 4.
Cyrtolites trentonensis Conrad. C 6 (?), 47.

3. Pteropoda.

Conularia trentonensis Hall. C 38.
Pterotheca expansa Emmons. C 40.

4. Cephalopoda.

Orthoceras tenuiseptum Hall. C 7.
Endoceras protiforme Hall. C 30, 31.
Oncoceras constrictum Hall. C 47.
Lituites undatus Emmons. C 12 (?).
Trocholites ammonius Conrad. C 45.

CRUSTACEA.

1. Trilobita.

Trinucleus concentricus Eaton. C 39–43, 47.
Asaphus canalis (Conrad) Whitfield. A 6–8. B 3, 4, 6, 8–11, 13, 15, 16. C 1, 3, 4, 6, 7, 10, 12, 16.
A. marginalis Hall. C 10, 12.
A. obtusus Hall. B 13, 15. C 12.

A. platycephalus Stokes. B 15. C 19–21, 23–25, 27, 28, 30, 33, 35–47.

Illænus americanus Billings. C 20, 26.

I. arcturus Hall. B 4, 7. C 6, 20, 23, 24.

I. ovatus Conrad. B 9–11, 15. C 4, 6, 7, 32.

Encrinurus vigilans Hall. C 36, 37, 39.

Bathyurellus validus Billings. B 13.

Bathyurus spiniger Hall. C 20, 24.

Calymene senaria Conrad. C 31–33, 35, 37, 39, 41, 42, 45–47.

Ceraurus pleurexanthemus Green. C 19, 24, 31, 35, 39, 46.

Dalmanites eboraceus Clarke. C 23, 24.

D. callicephalus Hall. C 23, 24, 37, 39, 43–47.

2. Ostracoda.

Leperditia amygdalina Jones. B 3, 4, 8. C 1, 3, 4.

L. canadensis var. nana Jones. A 7. B 6, 8–11, 15. C 1, 5, 6, 10, 12, 19–21, 24, 27.

L. fabulites Conrad. C 18–21, 23, 24.

Primita logani Jones. B 8, 15. C 19.

DESCRIPTION OF FOSSILS*

LINGULA Bruguière

Lingula brainerdi sp. nov., Pl. 18, figs. 2, 3

Shell subrectangular, expanding only slightly toward the front; beak small; apical angle very obtuse; posterior regularly rounded; front nearly straight, with gently curved angles. Greatest convexity about middle of valves; the anterior slope flattened. Surface marked by closely arranged fine lamellose lines of growth and partially exfoliated specimens show numerous fine radiating lines which are more common and strong near the middle of the valves.

The figures do not show the characters well owing to the poor specimens from which they were drawn. Better material has been obtained since from Valcour Island and will be figured at a later date.

Locality.—A 2. Crown Point, N. Y. Base of the Chazy, Valcour Island and Isle LaMotte.

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*All the fossils here described and figured are in the Museum of Paleontology of Cornell University.

RAFINISQUINA Hall and Clarke

Rafinisquina champlainensis sp. nov., Pl. 18, figs. 5, 6

Shell large, ventricose, almost hemisperical in some specimens. Length is to width as 6:7. Hinge line longer than the greatest width below; cardinal extremities often produced into short, broad, rounded ears; beaks small; ventral valve very convex, greatest convexity being about the middle of the valve; dorsal valve concave, but does not follow exactly the curvature of the ventral, the umbo being flattened.

Surface marked by numerous fine radiating striæ, about every third or fourth one being stronger than the ones between. The striæ increase toward the front by implantation. In the partially exfoliated state in which the specimens are usually found, the striæ appear nearly equal and the shell rather fibrous.

Locality.—In the middle portion of the Chazy at Crown Point, Valcour Island, Maclurea Point, and elsewhere along Lake Champlain.

STROPHOMENA Rafinesque (de Blainville)

Strophomena incurvata Shepard, Pl. 19, fig. 11

This well-marked fossil is rather common all through the Black River limestone in this section, but does not cross the line into the Trenton. It is reported as common in the Trenton of Minnesota, but in eastern and northern New York it is common only in the Black River and may be considered a characteristic fossil.

Locality.—Black River limestone. Crown Point, N. Y.

TRIPLECIA Hall

Triplecia gracilis sp. nov., Pl. 18, fig. 1

Shell small, nearly circular in outline, both valves moderately convex; greatest convexity about the middle of the valves; beaks small, that of the dorsal valve hardly extending beyond the hinge line; cardinal line short. The dorsal valve has a small rounded fold extending from the front about one-third the length of the shell. The sinus of the ventral valve is shallow, equal in length to the fold.

Shell thin, the surface marked by fine concentric striæ which undulate in crossing the fold and sinus. The surface of the cast is marked by very numerous fine, wavy, radiating lines.

This small species differs from *Triplecia nucleus* Hall in the presence of radiating markings, less convexity of valves, and in the shape and extent of the fold and sinus. It differs from the young of *Triplecia extans* Emmons in the shape and extent of the fold and sinus and in the length of the cardinal line.

Locality.—Found in zones A 8, B 7, 11, 13, 15, and C 12 of the Chazy limestone, Crown Point, N. Y. Also at Valcour Island, N. Y.

Triplecia extans Emmons, Pl. 19, fig. 4

This figure is introduced for comparison with *Triplecia gracilis* of the Chazy. It was drawn from a rather large specimen collected in zone C 27 of the Black River limestone.

PLECTORTHIS Hall and Clarke

Plectorthis plicatella Hall, Pl. 19, figs. 5, 6

Hall's description: "Broadly semioval, nearly æquivalve, length and breadth about 3 to 4. Surface marked by strong, radiating plicæ, which are usually simple, about 20 to 28 on each valve, crossed by simple elevated concentric lines, which are more distinct in the depressions between the costæ, and often obscure or obsolete upon their exposed surfaces; valves nearly equally convex without sensible depression or elevation on either one, meeting at the edges in a straight line; cardinal line not extending beyond the width of the shell; area narrow; dorsal foramen extending to the beak."

In the cast of the pedicle valve the muscular scars are subelliptical and small, but strongly impressed.

Locality.—Rather common in zones C 19, 20, 23, 24 of the Black River limestone, Crown Point, N. Y.

ECCULIOMPHALUS Portlock

Ecculiomphalus fredericus sp. nov., Pl. 18, fig. 4

Very loosely coiled, making but one volution; tapering rather abruptly at the apex; test thin, marked by distant lamellose lines of growth; cast rounded, smooth; section nearly circular.

Diameter of largest specimen, 3.5 cm. Greatest diameter of outer coil, 1 cm.

Locality.—Found rarely in zones B 7 and C 3, 6, 7. Chazy limestone, Crown Point, N. Y.

BUCANIA Hall

Bucania champlainensis Whitfield, Pl. 18, figs. 7, 8

Whitfield's description: "Shell of medium size for the genus, with the outer volution broadly expanded and much thickened, being somewhat heart-shaped on the margin of the lip. Inner volutions rounded and involved within the lip of the outer one to the extent of nearly or quite one-third of its diameter, but showing deep umbilical cavities on the sides. Number of volutions three or four."

Our specimens show a broad, fairly deep notch in the lip. The surface is marked by numerous lamellose lines of growth which bend backward at the notch, following the contour of the lip.

Locality.—Common in B 4 and C 9. Chazy limestone, Crown Point, N. Y.

MACLUREA Le Sueur

Maclurea magna Le Sueur, Pl. 18, fig. 10

This characteristic fossil of the Chazy is found at Crown Point at the top of section A, all through section B, and in section C up to zone 14, about 50 feet below the base of the Black River limestone. The specimens occur principally as casts, but many can be obtained which show the surface markings.

RAPHISTOMA Hall

Raphistoma lenticulare Emmons, Pl. 19, figs. 7, 8

Shell discoidal, spire depressed, flattened; volutions about four, body whorl wider than all the others. Suture deep in cast. Umbilicus about one-third the width of under surface, extending to top. Aperature subtrigonal, transversely extended; outer edge obtuse.

None of the specimens from this locality have the surface markings preserved.

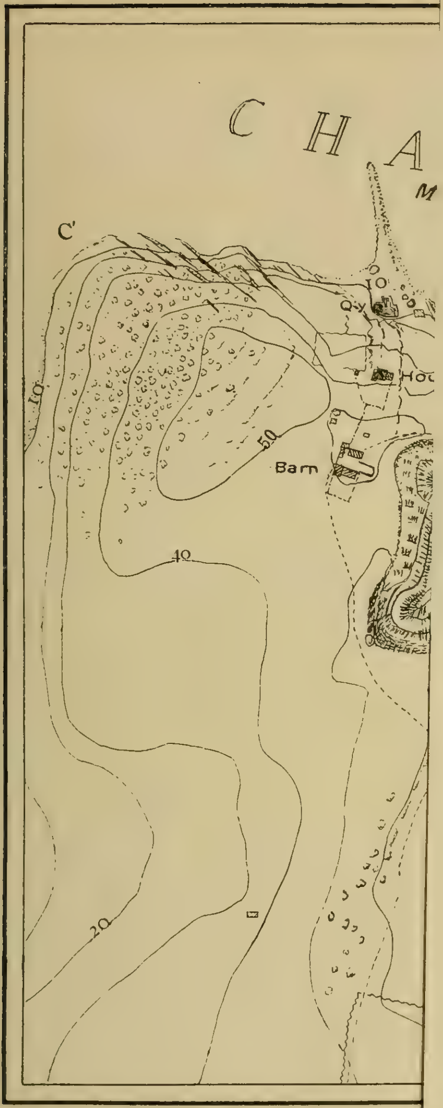
Locality.—Top of the Black River and base of the Trenton. C' 25, 30, 39. Crown Point, N. Y.

PTEROTHECA Salter.

Pterotheca expansa Emmons, Pl. 19, fig. 12

This obscure fossil is figured here in hope that the attention of other workers will be called to it. Its affinities seem to be rather doubtfully understood.

Locality.—Lower Trenton, Crown Point, N. Y.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Topographic Map of Northern
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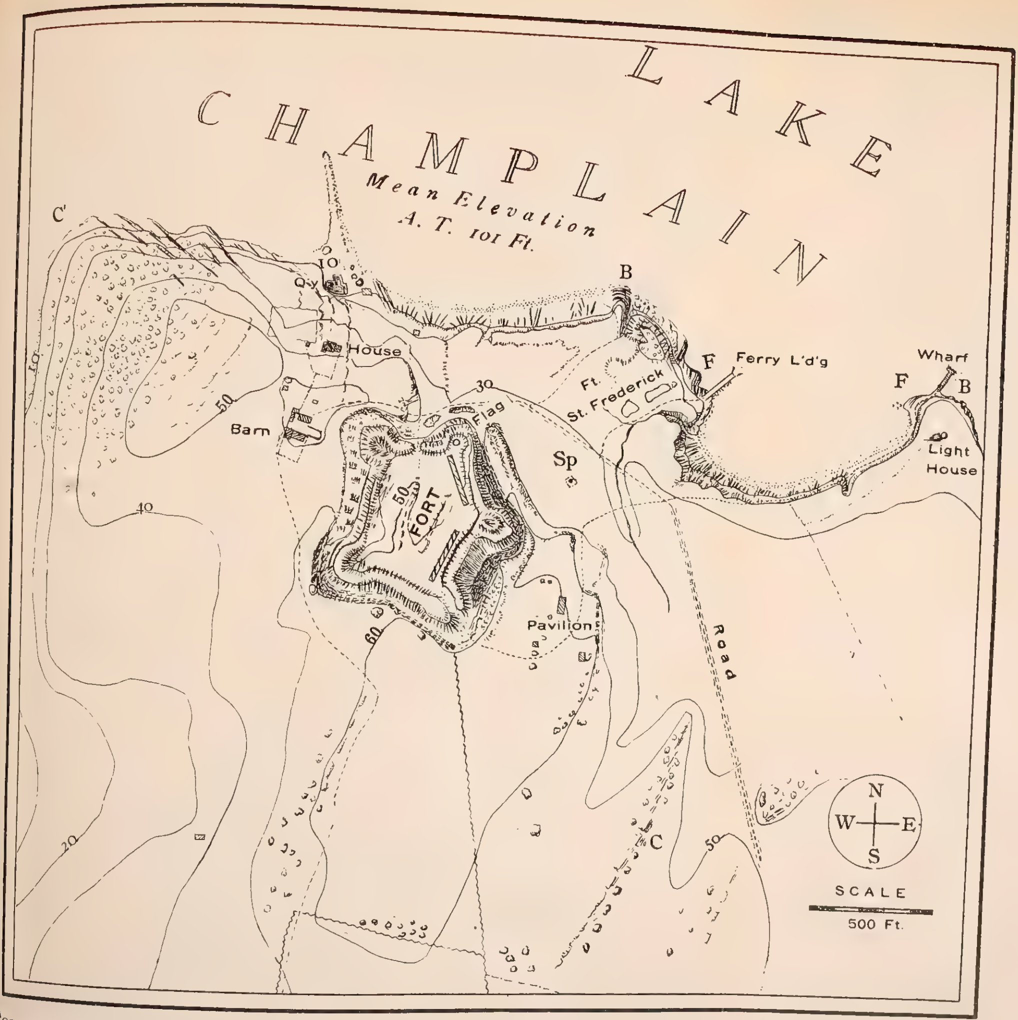
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Ferry L'd'g
Wharf
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B
Light House
C
10
30
40
50
60
20
N
W
E
S
SCALE
500 Ft.

Topographic Map of Northern End of Crown Point, Showing Location of Sections B and C. F, F Denotes Good Collecting.

[This Map was practically ruined by the Engraving Co. and we regret not having time to redraw it.—Ed.]

Plate 18

CHAZY FOSSILS

EXPLANATION OF PLATE 18

Page.

Fig. 1. *Triplecia gracilis* n. sp. A brachial valve........37, **303**

2. *Lingula brainerdi* n. sp. A partially exfoliated specimen showing radiating lines............36, **302**

3. A fragment of another specimen showing the surface markings.

4. *Ecculiomphalus fredericus* n. sp. A specimen preserving a part of the shell...................39, **305**

5. *Rafinisquina champlainensis* n. sp. A pedicle valve...37, **303**

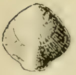
6. A side view of the same showing the great convexity.

7. *Bucania champlainensis* Whitfield. Looking down upon a somewhat crushed specimen, showing the outline of the lip..........39, **305**

8. Another view of the same specimen, showing the notch in the lip and the surface markings.

9. *Illænus ovatus* Conrad. The figure is that of a specimen from which the eyes and spines have been broken.

10. *Maclurea magna* Le Sueur. A small specimen preserving the surface markings and showing the gradual expanding of the volutions...39, **305**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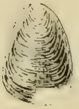
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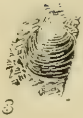
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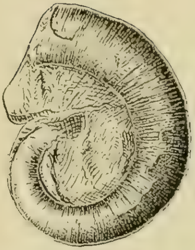
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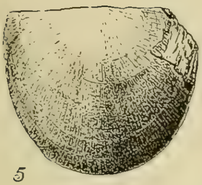
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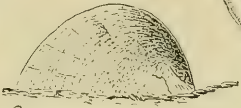
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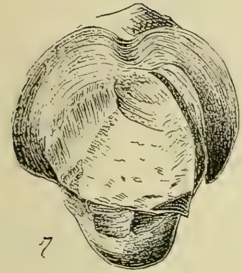
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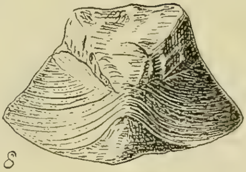
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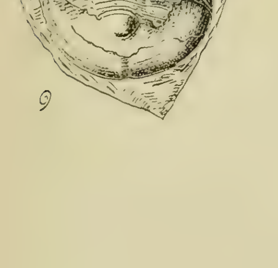
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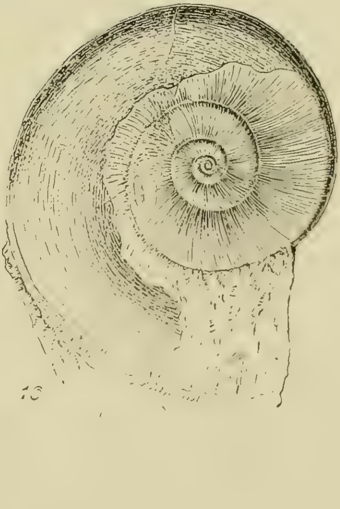
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Plate 19

BLACK RIVER AND TRENTON FOSSILS

EXPLANATION OF PLATE 19

Page.

Fig. 1. *Bathyurus spiniger* Hall. A glabella showing tubercles and the faint lateral grooves. Black River.

2. Pygidium of the same, showing the base of the spine and the tubercles on the end of the axis.

3. Side view of the same.

4. *Triplecia extans* Emmons. Dorsal valve of a large individual. Black River................38, **304**

5. *Plectorthis plicatella* Hall. Cast of the ventral valve, showing muscular scar. Black River..38, **304**

6. Cardinal areas of the same, showing pedicle opening.

7. *Raphistoma lenticulare* Emmons. Side view of cast. Trenton limestone........................40, **306**

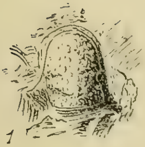
8. Top view of the same.

9. *Bucania punctifrons* Emmons. Side view of a medium sized specimen. Trenton.

10. Another view showing surface markings and carina.

11. *Strophomena incurvata* Shepard. Interior of a ventral valve. Black River.....................37, **303**

12. *Pterotheca expansa* Emmons. Trenton...........40, **306**



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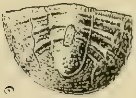

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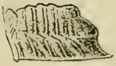

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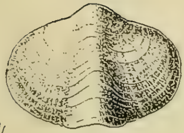

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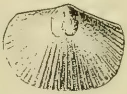

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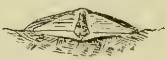

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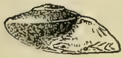

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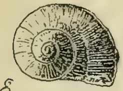

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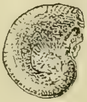

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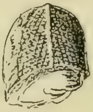

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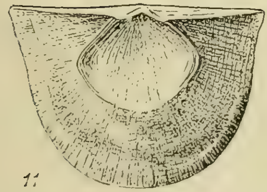

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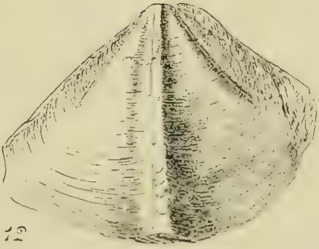

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FALLS OF MINT SPRING BAYOU, VICKSBURG (see page 72).

Vol. 3.

BULLETINS
OF
AMERICAN PALEONTOLOGY

No. 15

A COMPARISON OF THE OLIGOCENE OF WESTERN EUROPE AND THE SOUTHERN UNITED STATES

BY

CARLOTTA JOAQUINA MAURY.

A thesis presented to the Faculty of Cornell University for the degree of Doctor of Philosophy.

June 16, 1902.

Harris Company
Cornell University
Ithaca, N. Y.
U. S. A.

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INTRODUCTION

The validity of the correlation of certain beds of the southern United States with the European Oligocene, although generally assumed, may be regarded as open to question. The writer has, therefore, attempted a comparison of these deposits with the typical Oligocene beds of western Europe, as a contribution to the evidence on this subject.

To gain a general knowledge of the European Oligocene molluscan forms, studies were made at the Paris, Bordeaux and Brussels museums of paleontology. The geographical distribution of the species in the basins of Paris, Rennes, Mainz, the Gironde, the Adour, Belgium and northern Germany was also carefully noted.

During the spring and summer of 1900, field work was carried on in the French and Belgian Oligocene basins. The commoner and many of the characteristic species were collected from these beds. A nearly complete set of stratigraphic specimens was also obtained to illustrate the mineralogical characters of the horizons.

When possible, photographs were taken, but as the country is very level and of no great elevation in the Oligocene sections of France and Belgium, the camera could be used advantageously only in open quarries.

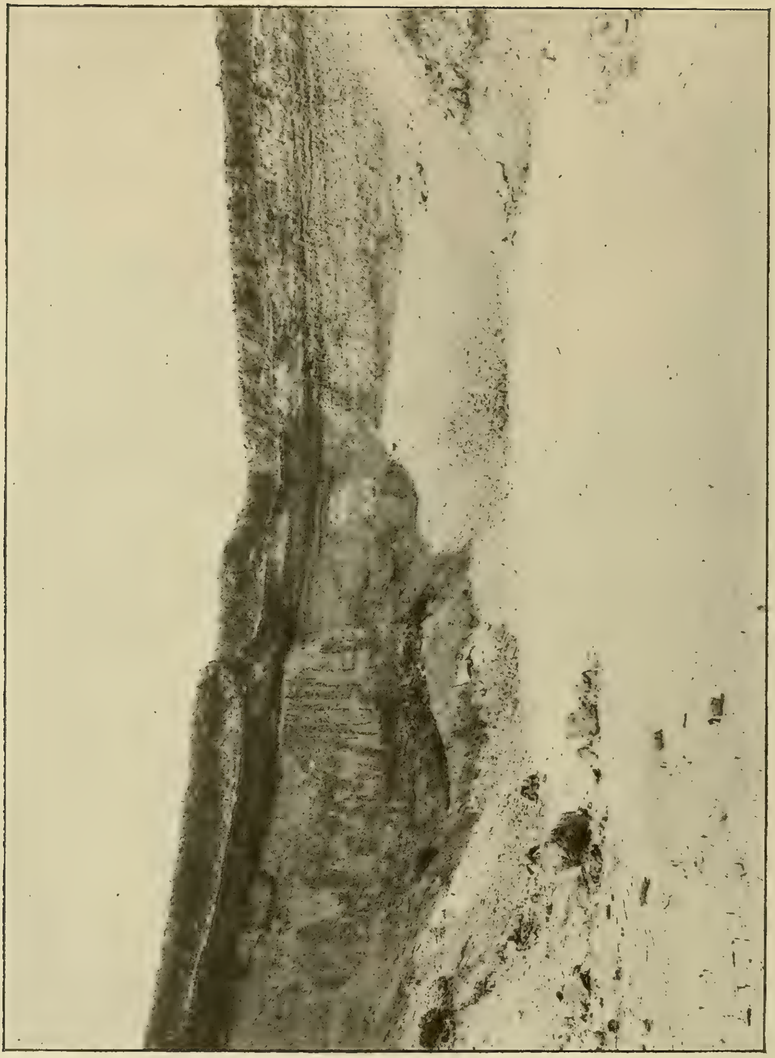
For purposes of comparison a brief review of the Oligocene of western Europe is given. A bibliography of species was also prepared. This list, while not absolutely complete or free from synonymes ,comprises several thousand species and is intended to serve as a practical University laboratory guide to the fauna.

Under the direction of Professor G. D. Harris, collections have been made, during several successive years, for Cornell University, of the Tertiary fauna of the southern United States.

The Oligocene material thus obtained has been studied and identified by the writer, kindly aided in cases of doubt by Dr. W. H. Dall and Mr. Vaughan of the Smithsonian Institution. Many new species in the collection can at present be classed only generically since similar specimens are in the Smithsonian collection awaiting description by Dr. Dall. A few new species not in the latter collection are described.

A number of sections and field notes made in 1900–1902 by Professor Harris in northern Florida, in Georgia, Alabama and Mississippi, illustrating Chattahoochee and Orbitoides limestones and Grand Gulf sandstones, have been placed by him at the writer's disposal.

The writer wishes to thank Professor Harris of Cornell, Professor Stanislas–Meunier and Monsieur G. Ramond of the Jardin des Plantes, Professor Fallot of the University of Bordeaux, Professor Van den Broeck and Professor Rutot, Curators of the Royal Museum at Brussels, for many courtesies and much practical help.



THE QUARRY AT JEURRE (see page 9).

PART I.

THE OLIGOCENE OF WESTERN EUROPE

Field Work in the Oligocene of France and Belgium.

The European fossiliferous deposits have been visited by collectors for so many years that in many localities the supply of fossils is greatly diminished, or even exhausted, as in the basin of the Adour. The level topography and consequence absence of natural sections make the collector dependent on artificial exposures such as are obtained in quarries and sand pits, or along roadside cuts. Of these quarries, some once famous for their fossiliferous beds have been long abandoned. That of Jeurre, where Deshayes and Lamarck obtained many Oligocene types, is filling up with material washed down from above. A photograph of this quarry as it now appears is shown on opposite page. The once equally noted sand pit of Morigny is to-day quite hidden in a thicket, and the fossiliferous sands are overgrown with grass and rendered almost inaccessible by the interlacing roots of trees.

In Belgium an obstacle was encountered which was practically insurmountable. The Government claimed a monopoly* of the building sands of the country and consequently ordered that many of the sand pits hitherto worked by private companies should be filled up. This resulted in the closure of many of the fossiliferous deposits, as, among others, that of Berg.

Nevertheless, the lithological characters of the principal beds were studied and samples of the deposits were collected. The writer was also fortunate enough to secure the following species:

+*Conovulus pyramidalis*, T. Sow.,†	Antwerp.
Limnæa strigosa,	Romainsville.
“ *ventricosa*,	Montmorency.
Planorbis cornu,	Romainsville.

---

* To avoid the taxation resulting from this monopoly, the peasants steal the sands by night. In many places holes, lightly covered with sod, are evidences of these depredations.

† A number of Pliocene species, which are indicated by a (+), are included in the list.

Tornatella simulata Sol.,	Boom.
+*Cylichna cylindracea* Penn.,	Antwerp.
Bulla (*Haminea*) *turgidula* Desh.,	Morigny.
+*Terebra inversa* Nyst,	Antwerp.
Conus aquitanicus Mayer,	La Saubotte.
+*Pleurotoma antverpiensis* Delh.,	Antwerp.
“ *belgica* Munster,	Morigny.
“ “ “	Jeurre.
+ “ *costata* Da Costa,	Antwerp.
“ *denticula* Bast.,	Steendorp.
“ *Duchasteli* Nyst,	“
“ *intorta* Brocchi,	“
“ *Konincki* Nyst,	“
“ *regularis* Van B.,	“
“ *Selysii* De Kon.,	Grimmertingen.
“ “ “	Steendorp.
“ *turbida* Sol.,	“
Cancellaria evulsa Sol.,	Boom.
Oliva Basterotina Defrance,	La Salle.
“ *Defresnei* Basterot,	La Saubotte.
“ *subclavatula* d'Orb,	Le Thil.
+*Voluta Lamberti* T. Sow.,	Antwerp.
“ *Rathieri*,	Grimmertingen.
“ *suturalis* Nyst,	“
Fusus Deshayesi De Kon.,	Steendorp.
“ *elatior* Beyr,	“
“ *elongatus* Nyst,	“
+ “ *gracilis* Da Costa,	Antwerp.
“ *multisulcatus* Nyst,	Steendorp.
“ *Waelii* Nyst,	“
+*Chrysodomus contraria* Sow.,	Antwerp.
Buccinum baccatum Bast., var.,	Lariey.
“ (*Pseudostrombus*) *Gossardi* Nyst,	Pierrefitte.
“ “ “	Morigny.
“ “ “	Jeurre.
“ “ “	Grimmertingen.

+	*Buccinum undatum* L.,	Antwerp.
	Nassa Aquitanica Mayer,	La Saubotte.
+	" *consociata* Sow.,	Antwerp.
+	" *labiosa* T. Sow.,	"
+	" *lamellilabra* Nyst,	"
+	" *propinqua* Sow.,	"
+	" *reticosa* T. Sow.,	"
+	*Buccinopsis Dalei* T. Sow.,	"
	Columbella curta (?),	La Saubotte.
	Typhis (*Lyrotyphis*) *cuniculosus* Desh.,	Morigny.
	" " " "	Grimmertingen.
	Murex Deshayesi Nyst,	Steendorp.
	" cf. *Lasseignei* Bast.,	Lariey.
	" *Pauwelsii* De Kon.,	Steendorp.
	" cf. *scabriusculus* Grat.,	Lariey.
	" *variabilis* Grat.,	"
+	*Acanthina tetragona* Sow.,	Antwerp.
	Triton Flandricum De Kon.,	Steendorp.
	" "	Grimmertingen.
+	*Cassidaria bicatenata* Sow.,	Antwerp.
	" *nodosa* Brand.,	Steendorp.
+	*Chenopus pes-pelicani* L.,	Antwerp.
	" *speciosus* Schloth,	Boom.
	Cerithium Boblayei Desh.,	Brunehaut.
	" *calculosum* Bast.,	La Garde.
	" (*Potamides*) *conjunctum* Desh.,	Morigny.
	" *corrugatum* Bast.,	Le Son.
	" *elegans* Desh.,	Vieux-Joncs.
	" *fallax* Grat.,	La Saubotte.
	" *margaritaceum* Brocchi,	Lariey.
	" *papaveraceum* Bast.,	La Salle.
	" (*Pirenella*) *plicatum* Lmk.,	Morigny.
	" " " "	Le Son.
	" " " "	Lariey.
	" *pupæforme* Bast.,	La Saubotte (?)
	" *sub-margaritaceum* Braun,	" "
+	" *tricinctum* Brocchi,	Antwerp.

Cerithium (*Potamides*) *trochleare* Lmk.,	Morigny.
Bittium spina Partsch,	Villeandraut.
Potamides Lamarcki Brongn.,	Franconville.
" " "	St. Martin.
" " "	Ormoy.
Turritella Desmaresti Bast.,	La Saubotte.
+ " *incrassata* T. Sow.,	Antwerp.
" *vasatensis* Tourn., (in coll.),	La Saubotte.
Bayania (*Melania*) *semidecussata* Lmk.	Étrechy.
" " " "	Pierrefitte.
+*Littorina suboperta* Sow.,	Antwerp.
+*Rissoa vitrea* Mont.,	"
Bithinia Dubuissoni Bouillet,	St. Martin.
Cyclostoma antiquum Brongn.,	" "
+*Pileopsis ungarica* L.,	Antwerp.
Calyptræa (*Galerus*) *labellata* Desh.,	Morigny.
" " "	Jeurre.
" (*Luna*) *striatella* Nyst,	Morigny.
" *sinensis* Desh.,	Lariey.
+ " "	Antwerp.
Xenophora Deshayesi,	Le Son.
Natica achatensis Recluz,	Steendorp.
" *Delbosi* Heb.,	Gaas, (Landes).
" *Hantoniensis* Pilk.,	Grimmertingen.
" (*Naticina*) *micromphalus?*, Sandb.,	Pierrefitte.
" " " "	Morigny.
+ " *millepunctata* Lmk.,	Antwerp.
" *neglecta* Mayer,	Lariey.
+*Adeorbis subcarinatus* Montagu,	Antwerp.
+*Eulima subula* Donov.,	"
Neritina Ferussaci (*Nerita picta*),	La Salle (La Brède).
+*Emarginula crassa* T. Sow.,	Antwerp.
Dentalium Kickxi Nyst,	Morigny.
" " "	Steendorp.
Ostrea cyathula Lmk.,	Argenteuil.
" " "	Villejuif.
+ " *edulis* L.,	Antwerp.

	Ostrea longirostris Lmk.,	St. Aubin.
	" *producta* Delbos,	Lariey.
	" *queteleti* Nyst,	Brouk.
	" *undata* Lmk.,	Sainte-Croix-du-Mont.
	" *ventilabrum* Goldf.,	Brouk.
+	*Anomia sphippium* L.,	Antwerp.
	Pecten bellicostatus Wood,	Brouk.
	" "	Grimmertingen.
+	" *Gerardi* Nyst,	Antwerp.
	" *Hoeninghausi* Defr.,	Klein-Spauwen.
	" " "	Steendorp.
+	" *maximus* L.,	Antwerp.
+	" *opercularis* L.,	"
+	*Pinna pectinata* L.,	"
	Mytilus Aquitanicus Mayer,	Lariey.
	Arca cardiiformis Bast.,	La Saubotte.
	" " "	Lariey.
	" *turonica* Dujardin,	Villeandraut.
	Pectunculus (*Axinea*) *angusticostatus* Lmk.,	Jeurre.
	" " " "	Morigny.
	" *cor* Bast.,	Château du Thil.
+	" *glycimeris* L.,	Antwerp.
	" *obvatus*,	Klein-Spauwen.
	" "	Jeurre.
	" "	Morigny.
	" "	Pierrefitte.
	Nucula Greppini Desh.,	Morigny.
	" " "	Jeurre.
+	" *lævigata* Sow.,	Antwerp.
	Leda Deshayesiana Desh.,	Steendorp.
	" " "	Boom.
	" " "	Tamise.
	" *gracilis* Desh.,	Jeurre.
	Cardita (*Actinobolus*) *Bazini* Desh.,	Pierrefitte.
	" *hippopea* Bast.,	Lariey.

	Cardita Kickxi Nyst & West,	Boom.
	" " " " "	Tamise.
	" " " " "	Steendorp.
	" *Omaliana* Nyst,	Klein-Spauwen.
+	" *orbicularis* Leach,	Antwerp.
+	" *scalaris* Leath,	"
	" *Tournoueri* Mayer,	Villeandraut.
+	*Astarte Basteroti* L.,	Antwerp.
+	" *corbuloides* Nyst,	"
	" *Henckeliusiana* Sow.,	Klein-Spauwen.
+	" *incerta* S. Wood,	Antwerp.
	" *Kickxi* Nyst,	Tamise.
	" " "	Boom.
+	" *Omaliusi* L.,	Antwerp.
	Cardium cingulatum (?) Goldf.,	Grimmertingen.
+	" *decorticum* S. Wood,	Antwerp.
+	" *edule* L.,	"
	" (*Cerastoderma*) *Raulini* Heb.,	Jeurre.
	" " " "	Morigny.
	" " " "	Pierrefitte.
	" *Stampinensis* Stan-Meun.,	"
	" (*Plagiocardium*) *tenuisulcatum* Nyst,	Morigny.
	" " " "	Jeurre.
	" " " "	Pierrefitte.
	Cyprina Islandica L.,	?
	" *rotundata* Braun,	Steendorp.
+	" *rustica* T. Sow.,	Antwerp.
	Isocardia cor L.,	"
+	*Cytherea chione* L.,	"
	" (*Pitar*) *incrassata* Desh.,	Morigny.
	" " " "	Jeurre.
	" (*Callista*) *splendida* Mer.,	Grimmertingen.
	" " " "	Pierrefitte.
	" " " "	Morigny.
	" " " "	Jeurre.
	" *undata* Bast.,	Lariey.
	" " "	La Garde.

Cytherea variabilis Stan-Meun.,	Pierrefitte.
Circe Deshayesi,	Lariey.
" "	Le Son.
" cf. *Banoni*,	Lariey.
+*Dosinia exoleta* L.,	Antwerp.
+*Venus casina* L.,	"
" *ovata* Penn. (1777),	Lariey.
Diplodonta Bezançoni Stan-Meun.,	Pierrefitte.
Axinus unicarinatus Nyst,	Boom.
Ensis siliqua L.,	Antwerp.
Cyrena convexa,	Near Paris.
" *semistriata* Desh.,	Klein-Spauwen.
+*Mactra arcuata* T. Sow.,	Antwerp.
Lutraria sanna Bast.,	Le Son.
" " "	Lariey.
+*Mya truncata* L.,	Antwerp.
Corbula carinata Duj.,	Lariey.
" *Henckeliusana* Nyst,	Jeurre.
" " "	Morigny.
" *pisum* (?) Nyst,	Klein-Spauwen.
" *striata* Walk. & Boys.,	Boom.
+*Corbulomya complanata* Sow.,	Antwerp.
" *Morleti* Stan-Meun.,	Pierrefitte.
" *triangula* Nyst,	"
+*Panopæa angusta* Nyst,	Antwerp.
+ " *Faujasii* M. de la G.,	"
Lucina dentata Bast.,	Lariey.
" *incrassata* Dub. de Montp.,	"
" (*Dentilucina*) *Heberti* Desh.,	Morigny.
" " " "	Pierrefitte.
" " " "	Jeurre.
" *ornata* Agassiz,	Lariey.
" (*Jagonia*) *squamosa* Lmk.,	Morigny.
" " " "	Jeurre.
" *undata* Lmk.,	"
Tellina Benedeni Nyst & West,	"
" (*Peronæa*) *Nysti*, Desh.,	"
+ " *obliqua* Sow.,	Antwerp.
+*Gastrana laminosa* T. Sow.,	"
+*Syndosmya prismatica*,	"

A REVIEW OF THE OLIGOCENE OF WESTERN EUROPE.

The Oligocene in Germany. The Oligocene of northern Germany is chiefly marine, while that of the valleys of the Oder, the Elbe and the Rhine is of freshwater or brackish origin.

The lignitic formation. The freshwater beds, which are gulf deposits, are composed of conglomerates, siliceous sands, sandstones, clays and shales; but lignitic remains of cypress and other coniferous woods predominate. At Cassel these lignitic beds are referable to the middle Oligocene (Rupelian). Similar deposits in the Rhenish provinces, however, probably represent the upper Oligocene (Aquitanian of Mayer). In 1864 Giebel* described the fauna of the lignitic formation.

Marine beds. Marine deposits representing the lower Oligocene (Tongrian) lie to the north of Berlin, and to the southwest of Magdeburg. The middle and upper Oligocene (Rupelian and Anquitanian) marine beds are, however, of greater importance and cover a large part of the northern plains of the country.

Geological map. A geological map of Germany, which has long been needed, is in preparation. Of this a portion was published in 1894 by Richard Lepsius,† but the complete map is presumably still unfinished.

Beyrich's classification of the marine beds. Beyrich, in 1853, made the following classification‡ of the Tertiary formation of northern Germany:

3. Beds equivalent to the Bordeaux formations........	Miocene ?
2. Septaria clays.....................	Fauna intermediate between Eocene and Miocene.
1. Magdeburg sands.................	

In his description of these beds Prof. Beyrich notes the strikingly intermediate character of the fauna of the Magdeburg sands and the Septaria clays. Nevertheless, he refers them both to the lower Miocene.

---

* Die Fauna der Braunkohl. form. Latdorf, 1864.

† Geologischer Karte des Deutschen Reichs.

‡ Die Conchylien der Norddeutschen Tertiärgebirges. *Zeitschrift der Deutschen geol. Gesellschaft*, 1853, 1855, 1856. Also published sep. vol. 8°.

Name Oligocene proposed, 1854. Continuing his researches, he found these faunal differences so constant that the following year, he referred the beds to an independent period. This he named the Oligocene,[*] and considered it as coordinate with the Eocene and Miocene periods.

Magdeburg sands. The Magdeburg sands, which represent the lower Oligocene beds in Germany, are characterized by *Ostrea ventilabrum*, *Arca appendiculata*, *Pleurotoma Beyrichi* and *P. subconoidea*. The sands are most fossiliferous near Neustadt-Magdeburg, Osterweddingen and Westerregln. The lower Oligocene fauna of these and other localities has been studied especially by Philippi,[†] Beyrich,[‡] Speyer,[||] and von Koenen.[§]

Septaria clays. The Septaria clays of Hanover and Mecklenburg, which correspond to the Septaria clays of Boom and Mainz, and represent middle Oligocene deposits, sometimes attain a depth of 160 metres. Foraminifera are very characteristic in these clays. The commonest molluscan species are *Leda Deshayesi*,

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[*] *Monatsbericht der Berliner Akademie der Wissenschaften* von Nov. 1854.

[†] Beiträger zur Kenntniss d. Tertiärversteinerungen d. Nordwestlichen Deutschlands. Cassel in 4°, 85 pp. 4 pl., 1843; Verzeichniss der in d. Gegend von Magdeburg aufgefundenen Tertiärversteinerungen. *Paleontographica* I, pp. 42–90, pl. 7, fig. 10a, 1847.

[‡] Die Conchylien der Norddeutschen Tertiärgebirges, Berlin, in-8°, 30 pl. Also published in *Zeits. d. Deutsch. geol. Gesellschaft*, V, VI, VIII, 1853, 55, 56.

[||] Ueber einige Tertiär-Conchylien von Westeregeln im Magdeburgischen. *Paleontographica*, IX, *zweiter Lieferung*, pp. 80–85.

[§] Die Fauna d. Unter-Oligocænen Tertiärschickten v. Helmstädt bei Braunschweig. Berlin, in-12°, 75 pp., 2 pl. (*Extrait du Journ. de la Soc. géol. allemande, année* 1865, p. 459, pl. 15 et 16); Beiträger zur Kenntniss der Mollusken-Fauna d. Norddeutschen Tertiärgebirge. *Paleontographica* part XVI, p. 145, pl. 12 to 14, 1866; Ueber die Unter-Oligocæne Tertiärfauna von Aralsee. Marburg, in-8°, 31 pp., 1869. (*Bull. de la Soc. imp. des Naturalistes de Moscou.* n. 1.)

See also Böttger, Osc., Beitrag zur päläontologischen u. geologischen Kenntniss d. Tertiärformation in Hessen. Offenbach, 1869.

Fusus multisulcatus, *F. elongatus*, *Pleurotoma intorta*, *P. Konincki* and *Borsonia gracilis*. Full discussions of the fauna are gived by von Koenen* and Speyer.†

Sands of Stettin. A somewhat later deposit than the Septaria clays are the sands of Stettin which usually overlie the clays and cover a wide area of the northern plains. The sands are characterized by *Pectunculus Philippi*, *Cardium cingulatum* and *Cyprina rotundata*.

Sands of Cassel and Bunde. At Bunde and Cassel are marine sands of upper Oligocene age, corresponding, as Beyrich anticipated in 1853, to the Bordeaux (Aquitanian) beds. The characteristic fossils‡ are *Echinolampus Kleini*, *Pecten Janus*, *P. Munsteri* and *Terebratula grandis*.

In 1827, Goldfuss published the first scientific treatise|| on the fossils of Germany. This was based on a study of private collections, especially that of Comte G. de Munster. A number of Oligocene species of various horizons are described in the work.

The Oligocene in Belgium. In Belgium, middle and lower Oligocene beds occur in the eastern part of the country in the province of Limbourg, and in central Belgium in the province of Brabant. The upper Oligocene is but little represented, and, as regards marine horizons, is wholly lacking.

Dumont's classification. Alexandre Dumont§ made the first classification of the Belgian Oligocene.

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* Das marine Mittel-Oligocæn Nord-Deutchlands u. seine Molluskenfauna, 1867, Cassel, 148 pp. (Extr. *Paleontographica*, *Band* XVI, pl. VI, VII, XXVI to XXX.

† Die Tertiärfauna v. Sollingen bei Jerxheim im Herzogthum Braunschweig. *Paleontographica* IX, 1864, 7 *Lief.*, p. 247.

‡ See Speyer, Die Conchylien der Casseler Tertiär-Bildungen. *Paleontographica*, Band XVI, 5 Lief., pp. 175-218 (1866-1869); also Bd. IX (1862-1864); Die oberoligocænen Tertiärgebilde u. deren Fauna in Fürstenthum Lippe-Detmold, in-4, 52 pp., 5 pl., *Paleontographica*, part XVI.

|| Petrefacta Germaniæ, Dusseldorf, 1827; second edition by Giebel, 1866.

§ Mémoire sur la constitution géologique de la province de Liège, in 4°. (Inseré dans les Mém. couronnés de l'Acad. roy. de Bruxelles).

Bolderian system.
Upper Rupelian system.
Lower “ “
Upper Tongrian “
Lower “ “

Tongrian. The name Tongrian was derived from the ancient Flemish town of Tongres,[*] not far from Liège in eastern Belgium, where typical lower Oligocene beds occur.

Rupelian. The name Rupelian was derived from the river Rupel, a tributary of the Escaut, since typical middle Oligocene exposures are found along the valley, as at Boom.

The Bolderian a Miocene horizon. Dana[†] refers the Bolderian to the upper Oligocene, which it was thought to be by Belgian geologists until 1884. In that year M. Van den Broeck[‡] showed that the Bolderian contains a typical Miocene fauna and should be properly placed in the lower Miocene. He attributes the error customarily made in regard to its geological position to the fact that, in some localities, Oligocene fossils have been washed into the Bolderian beds.

The classification of the Oligocene proposed by M. Van den Broeck[||] in 1894, was adopted by the Belgian government in 1896.

---

[*] The town itself is named from the Tongri who originally dwelt in the neighborhood. This tribe, under the leadership of the brave Ambiorix, resisted the Roman army with such determined courage that Cæsar himself was compelled to come from England to support his generals, and only by a war of extermination were the Tongri subdued. The Romans were obliged, by the continuance of this warfare, to remain several years in camp at Tongres. During this time an extensive wall and fortifications were built, the ruins of which are now the delight of archeologists. Pliny, who accompanied the army as historian, devoted himself to a study of the geology of the region. He described, in particular, a remarkable carbonated spring. This is generally identified with a large spriug near the town called the Fountain of Pliny.

[†] Manual of Geology, 1894, p. 926.

[‡] Note sur la découverte des fossiles miocènes dans les dépôts de l'étage bolderien à Wænrode. *Ann. Soc. R. Malac. Belgique*, t. 19, 1884. See also by the same author, Rapport sur une excursion faite le 16 juillet 1874 au Bolderberg, près de Heosselt, *Ann. de la Soc. Malacologique de Belgique*, IX, 1874.

[||] Coup-d'oeil Synthétic sur l Oligocène Belge. Bruxelles, 1894.

Classification adopted in 1896.

OLIGOCENE OF HIGH BELGIUM.

UPPER HORIZON.

Fluvio-lacustrine.	Plastic clays, variously colored, containing an Aquitanian flora.
	Sands and gravels. Cross-bedded stratification.
	Sandstone of Coudroy.
	Conglomerate of the Ardennes.
	Layers of white quartz pebbles.

LOWER HORIZON.

Marine (littoral).	Fine sands with traces of annelids. Meuse Valley.

OLIGOCENE OF MIDDLE AND LOW BELGIUM.

Rupelian (*Middle Oligocene*).

UPPER HORIZON.

Marine.	White sands, becoming argillaceous.
	Clay of Boom. *Leda Deshayesiana.*
	Sands.
	Coarse sands and gravel.

LOWER HORIZON.

Marine.	White sands.
	Clays. *Nucula compta.*
	Sands of Berg. *Pectunculus obovatus.*
	Green clays, alternating with sands.
	Flint gravel beds.

Tongrian (*Lower Oligocene*).

UPPER HORIZON.

Brackish.	Marls of Vieux-Joncs. *Cerithium elegans.*
	Green clays of Hénis. *Cytherea incrassata.*
	Sands of Bautersem. *Cyrena semistriata.*

LOWER HORIZON.*

Marine.	Green clays.
	Micaceous sands of Neerepen.
	Argillaceous sands. *Ostrea ventilabrum.*
	Sands.
	Plastic clays.
	Gravel beds.

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* The lower Tongrien is referred by Lapparent to the Eocene.

Fossiliferous beds of Limbourg. The fossiliferous beds of Limbourg, being the standard to which all lower Oligocene deposits are referable, have an important place in geological literature. In addition to the work of Dumont, already mentioned, the publications of Nyst,[*] Hébert,[†] Bosquet,[‡] Rutot,[||] Mourlon[§] and Van den Broeck[**] are important.

Ostrea ventilabrum beds. The *Ostrea ventilabrum* beds are best exposed in a sunken road which leads from Tongres to Brouk. Near that hamlet the steep sides of the road are formed of lower Tongrian sandy marls. These are concealed by sod and later formations except where a small open cave has been formed by undermining. The roof of this is full of *Ostrea* shells, especially the species *ventilabrum*, but *queteleti* is also fairly abundant. *Pecten bellicostatus* and *Cardium elegans* are common. A number of other species were also observed by the writer, but all excepting the *Ostrea* shells are so exceedingly fragile that they fall to pieces even on exposure to the air. To preserve the specimens it is necessary to soak them at once in gum arabic and allow them to dry thoroughly before attempting to transport them.

M. Vincent, director of the paleontological division of the Belgian survey, has identified some 42 species of mollusca from these beds. Among others he finds

Pinna margaritacea Lam.

Arca appendiculata J. Sow.

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[*] Récherches sur les coquilles fossiles de Hoesselt et Kleyn-Spauwen, province de Limbourg, 1836, *Extrait du Messager des arts et des sciences de Gand.*

[†] Sur les foss. tert. du Limbourg, etc., *Bull. Soc. Géol. de Fr.*, 2 *sér.*, t. VI, 1849, p. 466.

[‡] Récherches paléontologiques sur le terrain tertiaire du Limbourg neerlandais. Amsterdam, in-4°, 28 pp., 2 pl., 1859. (*Acad. des sci. naturelles d'Amsterdam*, D. VIII).

[||] Déscription de la fauna de l'oligocène inférieur de Belgique (tongrien de Dumont), Bruxelles, in-8°, 1876, 4 pl. (1re partie seule pub.). (*Ann. de la Soc. malacologique de Belgique*, t. XI, pp. 1-67).

[§] Géologie de la Belgique. 2 vol., in-8°, t. I, 1880, t. II, 1882. Liste générale de fossiles.

[**] Coupe d'oeil Synthétique jetté sur l'Oligocène Belge, 1894; and Rutot, Observations stratigraphiques relatives aux terrains oligocènes et quaternaires du Limbourg. *Ann. de la Soc. géol. de Belgique*, V, 1878, pp. 141-155.

Modiola Nysti Kickx.
" *Sandbergeri* Bosq.
Pleurotoma acuticosta Nyst.
" *Selysii* De Kon.
Pectunculus pulvinatus Lam.
Fusus elongatus Nyst.
Cancellaria evulsa Sol.
Natica labellata Lam.

Sands of Neerrepen and Grimmertingen. Although the sands of Neerrepen are exposed in a number of places, the only locality where fossils could be well obtained has been enclosed for more than 40 years in a private park in which collecting is forbidden. The sands are characterized by traces of annelids and valves of *Ostrea ventilabrum.* The deposit is littoral. Cross-bedding is frequent. The fauna is much the same as that of Grimmertingen, a hamlet 7 kilometers north of Tongres. At the base of the sands of Grimmertingen *Rostellaria*, *Ostrea*, *Pecten*, *Arca*, *Cardita*, *Pectunculus*, *Cardium*, etc., have been found; and in the upper layers, *Serpula*, *Murex*, *Fusus*, *Buccinum*, *Turritella*, *Natica*, etc. The utmost patience and care were neccessary in obtaining these specimens which were very fragile. For many years the supply of fossils at Grimmertingen has been exhausted, but all the species collected there and at Neerrepen are on exhibition at the Royal Museum in Brussels.

The lower Tongrian ends with the green clays, but this limit is for convenience only, and is not based on any marked break in the series.

Sands of Bautersem. The sands of Bautersem are usually very fine, snow-white or light green in color, and not micaceous. They contain no traces of annelids. *Cerithium*, *Cyrena* and *Limnæa* occur near the base.

Of the 32 species found in these sands the commoner are *Cyrena semistriata*, *Cerithium Lamarcki*, *Ostrea ventilabrum*, *Pectunculus lunulatus*, *Lucina Heberti*, *Astarte trigonella* Nyst, *Lucina Omaliusi* Desh., *Cytherea incrassata* J. Sow., *Psammobia stampinensis* Desh. and fruits of *Chara* associated with *Limnæa longiscata*.

The characteristic species are

Cerithium intradentatum Desh.
Limnæa longiscata Brongn.
Planorbis acuticarinatus Dunk.
Melania muricata E. Wood.

Bithinia tenuiplicata G. Vin.
" *inflata* Braun.
Bithinia hellicella Braun.
Cardium scobinula Mer.

The clays of Hénis. The clays of Hénis, so named because of the large brick and tile factories near that town, vary from pure plastic green clays, of great economic importance in tile making, to brownish black, sandy beds. The purer clays are found towards the upper part of the deposit. These are quite unfossiliferous and hence most valuable, because the presence of a single fossil is ruinous to a tile, since the lime becomes calcined in baking and leads to the disintegration of the tile. The sandy clays occurring towards the base of the formation often contain fossils, many of which are washed in from other beds, but *Cytherea incrassata* is sometimes found in place. While the clays of Hénis have no really characteristic species, some forms, rare in the underlying sands of Bautersem, become very common in the clays. Among these are *Neritina Duchasteli* Desh., *Modiola Faujasi* Brongn. and *Corbula pisum* Sow. Other species abundant in the clays are

Buccinum Gossardi Nyst.
Cerithium trochleare Lam.
" *cancellinum* G. Vin.
Cardium Kochi Semper.
Natica Nysti d'Orb.
Odostomia Semperi Bosq.
Turbonilla lævissima Bosq.
Cyrena neglecta Nyst.
Bithinia Duchasteli Nyst.

The sands of Vieux-Joncs. The sands and marls of Vieux-Joncs (Oude Biesen) are very fossiliferous, and the shells are best preserved in the park of the Château. Unfortunately, the writer found the park closed in the absence of the owner, but the same beds were observed further along the road. In this locality the marl was formed almost entirely of organic remains of which *Cerithium elegans* formed a large proportion. *C. Lamarcki* and *C. plicatum* were also observed in considerable numbers. The fauna of the Vieux-Joncs region is rich, but not varied, and comprises only about 50 species.

The characteristic species are

Buccinum Thierensi Bosq.
Teinostoma decussatum Sandb.
Cerithium limula Desh.
Bulla minima Sandb.

Odostomia Nysti Bosq.
" *acutiusculum* Braun.
Lucina Thierensis Héb.
Rissoa turbinata Defr.
Mytilus subfragilis d'Orb.
Dreissensia Brardi Brongn.

Other species common in the sands are

Buccinum Gossardi Nyst.
Cerithium elegans Desh.
" *plicatum* Brug.
" *Lamarcki* Brongn.
Pleurotoma costellaria Duch.
Natica Nysti d'Orb.
Neritina Duchasteli Desh.
Pectunculus lunulatus Nyst.

Fossiliferous Rupelian beds. Paleontologically, the most important beds of the middle Oligocene (Rupelian) are the sand of Berg and the clays of Boom. Of the species in these deposits some were described by Jean Kickx[*] in 1830. De Koninck[†] and Nyst[‡] later published important monographs. Comparatively recently M. Vincent of the Belgian survey has published a list[||] of the Rupelian fauna of Belgium.

The sands of Berg. As already noted, the writer found the sand pit at Berg, from which some seventy finely preserved species have been obtained, closed by order of the government. Another outcrop was then visited where *Pecten Hoeninghausi* was found to be very common, but still more abundant were the valves of *Pectunculus obovatus* which, by their number, distinguish these sands which lack markedly characteristic species. Among other mollusca reported as common in this deposit are

Voluta rathieri Héb.
Typhis cuniculosus Duch.
Triton Flandricum De Kon.
Cassidaria nodosa Sol.
Murex Deshayesi Nyst.
Fusus multisulcatus Nyst.

Nucula clays. The sands of Berg are followed by clays which are best developed in Limbourg and are characterized by *Nucula compta*. Otherwise the fauna is poor. The clays are somewhat arenaceous and the fossils poorly preserved. One rarely finds a perfect *Nucula*, but the clay is filled with nacreous fragments of the shells.

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[*] Synopsis Molluscorum Brabantiae, in-4°, 1 pl., 1830.

[†] Déscription des coquilles fossiles de Bæsele, Boom, Schelle, etc., in-4°, 1837; also in tome XI Mémoire de l'Académie royale des sciences et belles lettres de Bruxelles, 1838.

[‡] Note a propos des coquilles fossiles de Boom. *Bull. de la Soc. Géol. de Fr.*, 1re sér., t. XIV, p. 451, 1843; Déscription des coquilles et des polypiers des terrains tertiaires de Belgique. In-4°, 1845; also in *Mém. couronnés de l'Acad. royale de Bruxelles*, t. XVII, 697 pp., 15 pl.

[||] Nouvelle liste de la faune conchyliologique de l'argile rupelienne. *Ann. Soc. R. Malac. de Belg.*, t. XXIII, 1888, pp. 38-40.

The clays of Boom. The clays of Boom, which are developed in the valley of the Rupel, are of great importance economically in the manufacture of bricks and tiles. At Steendorp, Tamise and especially at Boom, are large quarries, the working of which constitutes an important industry. The excavations have been carried on at Boom so as to form a regular series of terraces. Hence the quarry is strikingly like a vast coliseum. On the terraces great numbers of concretions (Septaria) are found, some beautifully iridescent with iron pyrites. As has been noted in the preceding pages, similar concretions are extremely common in the corresponding beds in northern Germany. The characteristic fossil of these clays is *Leda Deshayesiana*, which can readily be collected at any of the quarries.

M. Delheid of Brussels has made an admirable collection of fossils (which the writer was fortunate enough to see) from these clays. The species of corals and of crustaceans were very striking. Among the molluscan species, which amount to about sixty, *Ficula concinna* Beyrich, *Xenophora scrutaria* Phil., *Cancellaria evulsa* Sol., *Dentalium Kickxi* Nyst, *Perna Sandbergeri* Desh. and *Cassis Rondeleti* Bast., are comparitively common.

The Oligocene of the Paris basin. The Oligocene of the Paris basin forms a broad sheet lying chiefly between the Marne and Loire rivers. It extends east to Epernay, west to Chârtres, south to Orléans and Blois, and north to Paris. It is surrounded by Eocene except on the south and southeast where Miocene and Cretaceous beds occur. In the Eocene which forms the northern boundary, isolated outcrops of Oligocene can be observed at Montmorency, Ecouen and other localities.

The literature on the geology of the Paris basin is so voluminious that reference can be made here only to those publications in which many original descriptions of species are to be found.

Of these the most important are the works of Lamarck,[*] Deshayes[†] and d'Orbigny.[‡]

Section of the Paris basin Oligocene. The Oligocene of the Paris basin comprises the following strata:

Beauce Limestones.	2. Limestone of the Beauce and Montmorency millstones.
	1. Clays. *Potamides Lamarcki.* Alternating marine and freshwater beds.
Fontainebleau sands.	8. Sands of Ormoy.
	7. Sands and gravels of Saclas.
	6. Sands and shell-marls of Pierrefitte.
	5. Sands of Vauroux.
	4. Sands and gravels of Étrechy.
	3. Sands of Morigny.
	2. Sands of Jeurre.
	1. Oyster-shell marls and friable sandstones of Étrechy.
Brie limestone.	1. Brie limestones.
Green clays.	2. Green clays. Strontium concretions.
	1. Foliaceous clays. *Cyrena convexa*, *Cerithium.*

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[*] Mémoires sur les fossiles des environs de Paris. (*Ann. du Muséum de Paris*, 1802-1810); Histoire naturelle des animaux sans vertèbres, 1815, 2ème éd., 1835.

[†] Déscription des coquilles fossiles des environs de Paris, 2 vols., 1854; Déscription des animaux sans vertèbres découverts dans le basin de Paris, pour servir de supplément à la déscription des coquilles fossiles des environs de Paris, Paris, 3 vols., 1856.

[‡] Prodrome de paléontologie stratigraphique, 2 vols., 1850.

See also Guettard, Mémoires sur le mineralogie des environs de Paris et sur les corps marins qui s'y trouvent *Histoire de l'Académie royale des sciences de Paris*, 1756.

Bruguière, Histoire naturelles des vers, 1792.

Cuvier et Brongniart, Essai sur la géographie minéralogique des environs de Paris, 1re éd., 1810, 2ème, 1822, 3ème, 1835.

Brongniart, Déscription géologique des environs de Paris, 1823.

Defrance, Tableau des corps organisés fossiles, Strasburg et Paris, 1824.

Bezançon, Déscription d'espèces nouvelles du bassin de Paris, *Journ. de Conchy.*, 3ème sér., 1870, pp. 310-323, Pl. X.

Bayan, Études critiques sur la collection de l'École des Mines, 1870-75.

	10. White clays. *Limnæa strigosa.*
	9. Blue clays.
Clays above the gypsum.	8. Gypsum (1st bed). Vertebrate fauna. *Palæotherium.*
	7. Yellow clays.
	6. Gypsum (2nd bed). Only Eocene species.
	5. Marls. *Lucina inornata.*
	4. Gypsum (3rd bed). A few Oligocene species.
	3. Yellow clays. *Pholadomya ludensis.*
Gypsum.	2. Gypsum (4th bed). Fauna resembling Eocene.
	1. Green sands of Argenteuil.

Base of the Oligocene series. The basal beds of the Oligocene in the Paris basin are not definitely determined. This is due to the lack of unconformity, the scarcity of well preserved fossils in the gypsum beds and the contradictory evidence given by the species which occur. Thus the fourth bed contains species closely resembling those from the Eocene (sables moyens). The third bed has mostly Eocene species, but contains also a few new, Oligocene types. The second bed is nearly unfossiliferous, but what species there are, are Eocene. The first bed is characterized by vertebrate remains, especially those of *Palæotherium.* Lapparent considers that the Oligocene series begins with the blue clays which rest on the first gypsum bed. Cossman and Lambert include the gypsum in the Oligocene. Others claim that the green clays characterized by *Cyrena* are the true base of the series.

Clays above the gypsum. The clays above the gypsum are lake deposits. The principal species are *Planorbis planulatus*, *Limnæa strigosa* and *Nystia plicata.* These clays are well developed at Pantin, near Paris, and extend east to Château-Thierry.

The green clays. The green clays, four or five metres thick, overlie the white clays and contain a brackish and marine fauna. These beds at the base are very foliaceous, yellowish and characterized by *Cyrena convexa.* Above, the clays become bluish, and, in some localities, are rich in *Cerithium plicatum*, *C. trochleare* and *Psammobia plana.* The highest layers are green, and often contain concretions of sulphate of strontium. *Cyrena convexa* sometimes occurs. These layers of the green clays are used for the manufacture of tiles. In their southward extension towards Étampes, the green clays become unfossiliferous.

Brie limestone. The green clays are followed by the Brie limestone, a freshwater formation containing, though rarely, *Limnæa cornea*, *Planorbis cornu*, *Nystia Duchasteli* and fruits of *Chara*. The limestone forms most of the plateau of the Brie which lies to the east of Paris. Near Argenteuil, at Sannois and Orgemont, this freshwater limestone is replaced by marine marls with *Cerithium plicatum* and *Cytherea incrassata.*

Sands of Fontainebleau. The sands of Fontainebleau, with a rich marine fauna, overlie the Brie limestone. The sands are best developed in the vicinity of Étampes. They have recently been described* in much detail by M. Cossmann and M. Lambert.

Oyster-shell marls. A sudden change from the freshwater horizon of the Brie to marine conditions is indicated by the oyster-shell marls, a littoral deposit at the base of the Fontainebleau sands. These marl beds† extend from Paris to Lonjumeau. From that town southward to Étrechy, the deposit becomes arenaceous and forms a friable sandstone. At the outskirts of Paris, near Villejuif, the oyster-shell marls contain quantities of *Ostrea cyathula;* but the larger species, *O. longirostris*, becomes more common to the southward. In addition to these characteristic species of *Ostrea*, *Cytherea incrassata*, *Natica crassatina* and *Cerithium plicatum* are common in the marls.

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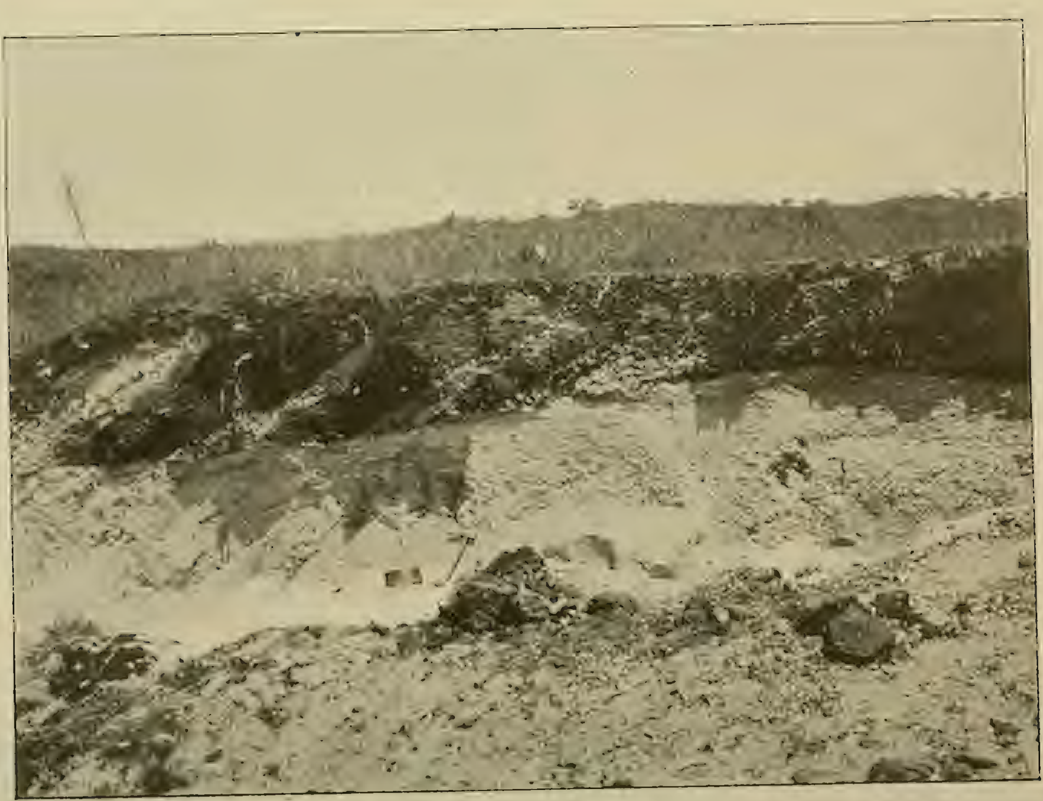
*Cossmann et Lambert, Étude Paléontologique et Stratigraphique sur le Terrain Oligocène Marin aux Environs d'Étampes; *Mémoires de la Société Géologique de France*, 3ème série, tome III, 1re partie, 1884.

Cossmann, Déscription de deux espèces nouvelles du tongrien des environs d'Étampes, *Jour. de Conchyliologie*, vol. XXVII, 1879, p. 436, pl. 13.

Lambert, Sables Oligocènes d'Étampes, *Bull. Soc. Géol. de Fr.*, 2ème série, t. IX, pp. 496-499. See also Ibid., 3ème série, t. X, p. 501.

† Hébert, Ed., Notice sur les fossiles tertiaires du Limbourg et sur ceux de la couche à *Ostrea cyathula* du bassin de Paris, *Bull. de la Soc. Géol. de Fr.*, 2ème série, t. VI, p. 459, 1849.

Dollfus, Coupe géologique de Chemin de Fer de Mery-sur-Oise, *Bull. Soc. Géol. de Fr.*, 3ème sér., t. VI, pp. 266, 299.



FOSSILIFEROUS SANDS OF MORIGNY IN THE QUARRY AT JEURRE (see page 29).

A local change of elevation during the deposition of these beds is shown by a freshwater layer of white clay at Lonjumeau in the upper layer of the Étrechy sandstone. This layer is characterized by *Paludestrina Dubuissoni.*

Shell marls of Jeurre. The shell marls of Jeurre, a hamlet near Étampes, from which Deshayes obtained many of his Oligocene (lower Miocene) types, are composed of sandy yellowish marls, of no great depth, but very fosssiliferous. In the quarry at Jeurre, of which a photograph, taken by the writer in 1900, is shown opposite page 9, these marls rest on the *Ostrea* bed. Unfortunately, the quarry has not been worked for so long that this contact is now obscured and the shell marl forms most of the floor of the quarry. The characteristic species are *Gastrochæna Rauliniana*, *Corbula subpisum*, *Symdosmya Sandbergeri*, *Cytherea Stampinensis*, *Deshayesia*[*] *parisiensis*, *Purpura monoplex*, *Trochus subcarinatus* and *Nummulites Bezançoni.*

Sands of Morigny. The deepwater deposit constituting the sands of Morigny lies above the shell marls at Jeurre. In the photograph of the quarry of Jeurre the sands of Morigny lie to the left of the center, a few feet up from the base. A nearer view of these, on the opposite side of the quarry, is shown in the photograph on the opposite page. At this point the sands are exceedingly fossiliferous. They are especially rich in *Pectunculus* and *Cytherea*, but many of the shells fall to pieces when handled. Near the little hamlet of Morigny the species in the same sands are better preserved, but collecting there, as already explained, is now difficult as the sand pit is overgrown with vegetation. *Pectunculus obovatus*, *Cytherea splendida*, *C. incrassata*, *Cardium tenuisulcatum*, *Lucina Heberti*, *Buccinum Gossardi*, *Pleurotoma belgica*, and especially *Cerithium trochleare*, can still be obtained in this locality.

Sands of Étrechy. The sands and gravels of Étrechy rest unconformably on the sands of Morigny, and indicate a long period of denudation following the deposition of the latter sands.

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[*] Raulin, Sur un genre nouveau (*Deshayesia*), *Magasin de zoologie*, 2ème sér., t. II, p. 111, pl. 3, 1844.

Only fragments of *Haleotherium* and teeth of *Lamna* are found in this littoral deposit.

Sands of Vauroux. The sands of Vauroux are shallow estuary deposits. At the base are white sands, often micaceous. At Étampes they contain *Lucina Thierensis*, *Corbulomya triangula*, and, at Vauroux, *Syndosmya elegans.* Although species of *Potamides* and *Cyrena* were also found, these beds are not as a rule fossiliferous. The sands of Vauroux were first described by Mayer* in 1864.

Sands of Pierrefitte. The best section of the sands of Pierrefitte is in a sand quarry near the hamlet of Pierrefitte. A photograph of this quarry, taken by the writer in 1900, is shown on the opposite page. This shows the manner in which these fine sands change laterally into coarser material. The sands are very white, and rest on a coarse gravel bed containing eroded fragments of shells. Some estuary species are found, but the fauna is in general marine. *Corbulomya triangula* and species of *Murex* and *Fusus* are very common, but the characteristic species is *Cardita Bazini.* The fauna has been described in detail by Professor Stanislaus-Meunier† and M. Cossmann.‡

Sands of Saclas. The sands and gravels of Saclas are not fossiliferous, except for teeth of *Lamna.* The sands are developed to the south of Étampes.

Fontainebleau sandstone. The sands of Ormoy (Fontainebleau sandstone) are of great economic importance. It is of this stone that Paris is built. Fossils are rare and usually in the form of casts, but, occasionally, when the stone has weathered and crumbled into fine sand, fossils can be obtained. Among these are *Cerithium plicatum*, *Potamides Lamarcki*, *Murex conspicuus*, *Cardita Bazini* and *Cytherea incrassata.*

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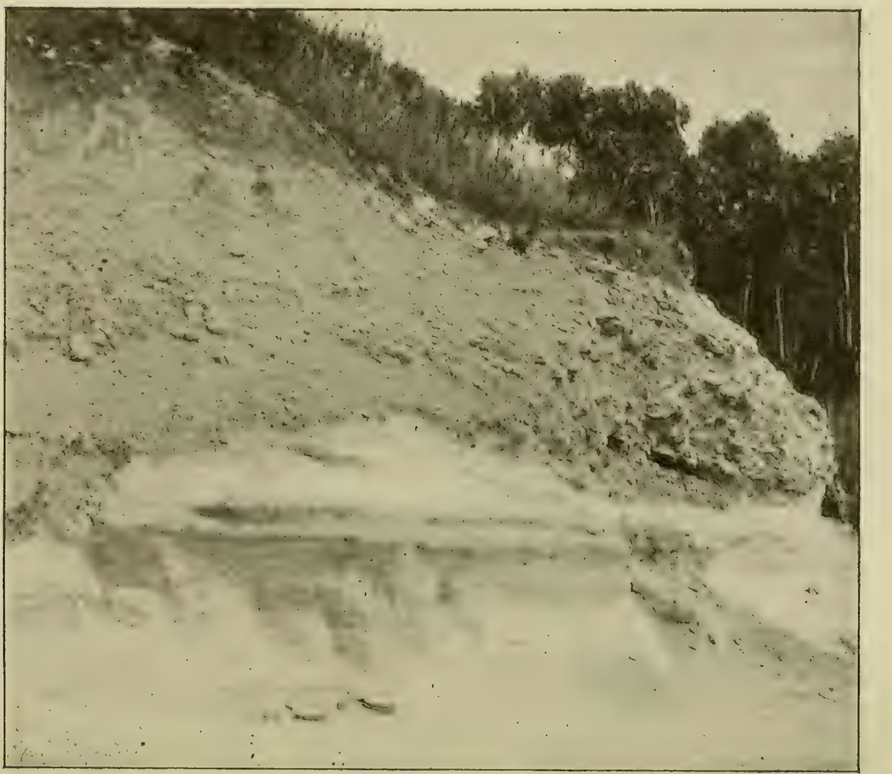
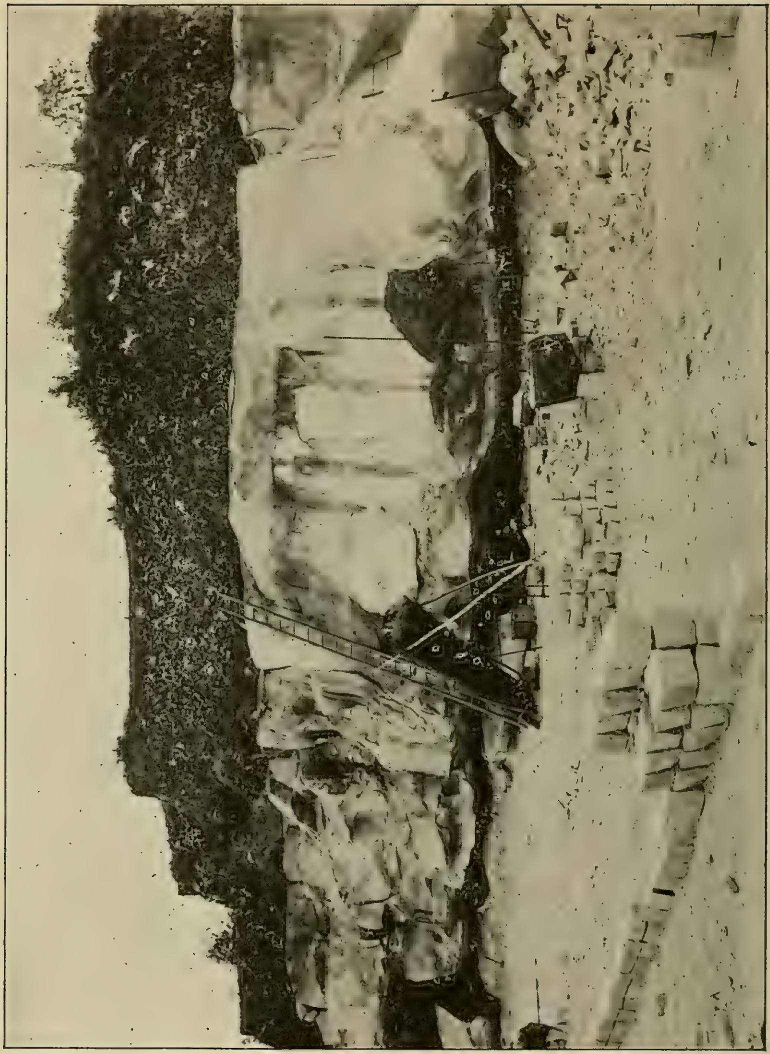
* *Journ. de Conchyliologie*, 1864.

† Sables supérieures de Pierrefitte, *Comptes rendus de l'Acad. des Sci.* t. LXXXIX, p. 611. See also Meunier et Lambert, Récherches stratigraphiques et paléontologiques sur les sables marins de Pierrefitte, près d'Étampes, *Nouv. Arch. du Mus.*, 2ème sér., t. III, pp. 235-268, pl. 13 et 14.

‡ *Mém. Soc. Géol. Fr.*, 3ème sér., t. 3, pt. 1, 1884.



THE QUARRY AT PIERREFITTE (see page 30).



THE QUARRY AT ORSAY (see page 31).

At Chalo-Saint-Mars this marine fauna occurs above a thin lignitic bed with *Potamides Lamarcki* and *Paludestrina Dubuissoni*, thus foreshadowing the deposition of the Beauce limestone, and showing the close connection between the latter and the sandstone.

Beauce limestone. A photograph, taken in 1900 in the quarry at Orsay, is shown on the opposite page. It shows an interesting contact between the marine Fontainebleau sandstone and the freshwater Beauce limestone. The sandstone, which is being quarried for building purposes, is stained with manganese. Directly upon its upper surface, rests the limestone. The latter rock, which is in part silicified and resistant, and in part disintegrated by chemical action, is extremely irregular and cavernous in its structure. No fossils were obtained at Orsay, but *Potamides Lamarcki* and *Cyclostoma antiquum* were collected at other localities in this limestone. At Montmorency the Beauce limestone has undergone silicification to such an extent that millstones occur locally.

The Stampien period. M. Cossmann and M. Lambert have proposed the name Stampien* for the period between the deposition of the sands of Étrechy and those of Ormoy.

The lower sands of Fontainebleau fall under the Rupelian. The Tongrian is represented by the Brie limestone and the clays and, perhaps, the gypsum.

Oligocene in Brittany. Although nearly all of the peninsula of Brittany is of igneous rock, several very local Oligocene deposits occur. These are most important in the vicinity of Rennes. Near that city is a coarse-grained limestone which was correlated by Desnoyers, in 1831,† with the Eocene limestone (calcaire grossier) of the Paris basin.

Limestone of Rennes characterized by Archiacina. Tournouer, however, in 1868,* recognised the true position of this limestone as of the same age as the sands of Fontainebleau. In 1872,† he obtained further evidence from a study of the fauna in more detail. This revealed the presence of *Natica crassatina*, *N. augustata*, *Turbo Parkinsoni*, *Cerithium plicatum*, *C. trochleare* and *Cytherea incrassata*, which proved beyond question the correctness of his earlier conclusion. Vasseur,‡ after a comparative study, in 1881, confirmed the views of Tournouer.

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* From the Latin name for Étampes where these beds are typical. *Mém. Soc. Géol. de Fr.*, 3ème sér., t. 3, pt. 1, 1884.

† Note sur les terrains tertiaires du nord-ouest de la France, autres que la formation des faluns de la Loire, *Bull. Soc. Géol. de France*, 1re série, t. II, p. 414, 4 juin, 1831.

The limestone of Rennes is especially characterized by Foraminifera of the genus *Archiacina*. Other fossils are rare and are found only as casts.

Freshwater limestone and clays. The upper layers of the limestone are brackish and freshwater deposits, with a fauna comprising species of *Potamides*, associated with *Planorbis* and *Limnæa*. These layers are overlaid by clays of freshwater origin containing *Potamides Lamarcki*, *Cyclostoma antiquum* and *Paludestrina Dubuissoni*.

The freshwater limestone and clays of Rennes represent the Beauce limestone of the Paris basin.

Relation of the Rennes fauna to that of Bordeaux. The marine fauna of Rennes has been found to be more closely related to that of Bordeaux than to that of the neighboring Parisian basin. It has also very few species in common with the Belgian Oligocene. But the presence in the Rennes basin of *Natica angustata*, *Turbo Parkinsoni*, *Lævicardium aquitanicum* and other species which are common in the Gironde valley, and total strangers in the basins of northern Europe, has suggested the connection of the Rennes basin, by way of Nantes, with that of Bordeaux.

Oligocene in southwestern France. The Oligocene in southwestern France outcrops in the valleys of the Gironde and the Adour.

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* *Bull. Soc. Géol. de France*, 2ème sér., t. XXV, p. 367, 1868.

† *Ibid.*, t. XXIX, p. 481, 1872.

‡ Récherches géol. sur les terrains tertiaires de la France occidentale, Paris, 1881.

Oligocene of the Gironde valley. The Oligocene of the Gironde valley is strongly developed on the right (northeastern) side of the Garonne. Thus the large areas between the Garonne and the Dordogne rivers, and between the Garonne and the Lot. are made up almost entirely of deposits of this epoch. In addition, there are smaller areas, two north of the Dordogne in the vicinity of Fronsac and St. Emilion, and one at Bourg, near the junction of the Garonne and the Dordogne.

On the left (southwestern) side of the Garonne there are no large areas, but exposures of this formation occur along the valleys of the many small tributaries of the river. Of these outcrops, the most famous are those near Martillac, Saucats. La Brède and Bazas.

On the left side of the Gironde, where it widens, forming the gulf, there are several outcrops as at Lesparre and Pauillac.

A valuable discussion of the Oligocene of the Gironde valley was published in 1895 by M. Fallot[*] of the University of Bordeaux. M. Fallot's contribution, which has done much in elucidating the stratigraphy and paleontology of the region, has been used as the basis of the following summary:

Section of the Gironde Oligocene. The Oligocene of the Gironde vallley may be regarded as typical near Brazas. The beds are greatly modified near Bordeaux.

	Bazas.	*Bordeaux.*
	3. Grey limestone of Agen.	3. Limestone of Le Son. Shell marl of Lariey. Freshwater limestone near Saucats.
Aquitanian.	2. Sandstone of Bazas.	2. Yellow sandy rock exposed in valleys.
	1. White sandstone of Agen.	1. Marl with *Neritina Ferusacci* (*Nerita picta*).

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[*] Contribution a l'étude de l'étage tongrien dans le Dépt. de la Gironde, *Mém. Soc., des Sci. phys. et Nat. de Bordeaux*, 1895, Tome V, p. 269. See also Esquisse Géologique du Dépt. de la Gironde, *Feuilles des jeunes Naturalistes*, 1889, and Esquisse d'une carte géologique des environs de Bordeaux, 1895.

5. Friable limestone of Agen.
4. Limestone characterized by *Asterias*.
3. Clays with *Ostrea longirostris* and *O. cyathula*.
Tongrian. 2. Freshwater limestone of Castillon and Civrac.
1. Friable sandstone of Fronsac and clays with *Limnæa* and *Planorbis*.

Sandstone of Fronsac. The friable sandstone of Fronsac varies from a loose sandstone to sandy clays, greenish and more or less micaceous. The formation which is typical at Fronsac extends along the valley of the Dordogne and of the Dronne, and is developed principally to the north of Coutras.

Occasionally there is no trace of underlying Eocene, and the sandstone then rests* directly upon the Cretaceous as at La Clotte. At Fronsac, however, the sandstone overlies clays which contain *Limnæa*, *Planorbis* and *Melanopsis mansiana*, a species found in clays above the gypsum in the Paris basin at Pantin. Hence M. Vasseur has coordinated these beds.

The sandstone of Fronsac is, in general, unfossiliferous. The only fragments which can be identified are those of turtles of the genus *Trionyx*, and of the large vertebrate *Paleotherium girondicum*, both forms indicating the lake origin of the sandstone.

Limestone of Castillon and Civrac. The freshwater limestone of Castillon and Civrac is irregularly developed. On the right bank of the Garonne it is important only to the eastward of St. Emilion, as far as Castillon. Along the Dordogne, the limestone also developes to the eastward, and, at Saint-Foy-la-Grande, reaches a depth of 20 metres.

On the left bank of the Gironde, this formation is especially well developed in Médoc, near the town of Civrac. It appears again, though in an argillaceous form, at Vertheuil,† Saint-Sauveur, Blanquefort and other localities.

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* Potier et Vasseur, Sur les formations *infratongriennes* du Bassin de la Gironde, *Soc. Lin. de Bord. C. R. des Séances*, 18 Juillet, 1888.

† Benoist, E., Déscription Géologique et Paléontologique des communes de Saint-Estèphe et de Vertheuil, *Extrait des Actes de la Soc. Lin. de Bordeaux*, t. 39.

When typical the limestone is white and compact, with silicified layers which are sometimes used for millstones.

The fauna is poor. The only really characteristic fossil is *Nystia Duchasteli*, but a few Limnæas have been found. From the presence of *Nystia Duchasteli*, the limestone of Castillon is thought to be the equivalent of the Brie limestone of the Paris basin.

The Ostrea clays. The clays characterized by *Ostrea longirostris* and *O. cyathula* (*O. girondica*) usually precede the limestone with *Asterias*. The oyster beds, themselves, rest either on the limestone of Castillon or on the sandstone of Fronsac. The basal layers of the oyster beds are rich in foraminiferas.

Asterias or Bourg limestone. The limestone characterized by *Asterias* is typical at Bourg. Since this is a coarse-grained, yellowish limestone, Deshayes, Brougniart and others regarded it as equivalent to the Eocene limestone of the Paris basin (calcaire grossier). Des Moulins named the Asterias limestone from the number of *Crenaster lævis* that it contains. But although he observed the close resemblance of the Bourg fauna to that of the oyster marls and green clays of the Paris basin, he still considered the limestone as an Eocene formation.

M. Raulin,* in 1843, in an article on the tertiaries of the Gironde, and in all his later publications, attempted to discriminate between the Bourg limestone and that of St. Micaire, considering the former as Eocene and the latter as Miocene. But Delbos,† Tournouer,‡ Matherson|| and Linder§ proved that these limestones are identical and equivalent to the sands of Fontainebleau of the Paris basin.

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* Nouvel Essai d'une classification des terrains tertiaires de l'Aquitaine, 1848; Resultat des Excursions faites dans le partie O. du Dépt. des Landes, 1864-9.

† Rapport sur une excursion géologiques aux environs de Blaye, *Act. Soc. Linn. Bord.*, t. XIII, 1870.

‡ Recensement des Echinodermes du Calcaire à Asteries, *Extrait des Actes de la Soc. Linn. de Bord.*, t. XXVII, 1870.

|| Notes sur les dépôts tertiaires du Médoc et des Environs de Blaye, etc., *Bull. de la Soc. Géol. de Fr.*, 2ème sér., t. XXIV, p. 197, 4 Fev., 1867.

§ Observations sur les dépôts tertiaires du Médoc et du Blayais dans le Dépt. de la Gironde, 1873, *Comptes rendues de la Soc. Linn. de Bord.*, 1874.

The Bourg limestone is the most important of the lower Oligocene deposits of the Gironde valley. The depth varies from 1 to 60 metres. Near Bordeaux it is quarried as a building stone.

The fossils* are usually found only in casts. Some of the more characteristic are *Crenaster lævis*, *Natica crassatina*, *N. angustata*, *Cerithium plicatum*, *C. trochleare*, *Trochus Buchlandi* and *Archiacini armorica.*

Friable limestone of Agen. The friable limestone of Agen is considered by M. Fallot as an eastern extension of the Bourg limestone.

Affinities of the Gironde Tongrian fauna. As already noted, the Tongrian fauna of the Gironde is more closely related to that of the limestone of Rennes, in Brittany, than to any other deposit in France. Its closest affinities are, however, with the Italian fauna.

Aquitanian. The upper Oligocene period (Aquitanian) in southwestern France was characterized by changes in elevation which resulted in alternate freshwater and marine deposits. The fauna has been studied by Basterot,† Mayer,‡ Benoist,|| Degrange-Touzin,§ Fallot and others.** The name Aquitanian was given

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* Fallot, Contr. a l'étude de l'étage tongrien, *Mém. Soc. Sci. phys. et nat. de Bordeaux*, t. 5, 1895.

† Déscription géol. du bassin tertiaire au S. O. de la France, in-4°, 1825, (*Extrait des Mém. de la Soc. d'hist. nat. de Paris*, t. 2, pt. 1, 1825).

‡ Déscription de coquilles fossils des terrains tertiaires inférieurs, *Journ. de Conch.*, 3ème sér., t. IV, p. 170, pl. 9; t. XII, pp. 168-181, 350-361, 1864; Déscription de coquilles fossiles des étages supérieurs des terr. tert., *Ibid.*, t. VII-X, XII, XIV, XVI, 1857-69.

|| Catalogue synonymique et raisonné Testacés Fossiles récueilles dans les faluns miocènes des communes de La Brède et de Saucats, pp. 5-78, 265-460, *Actes de la Soc. Linn. de Bord.*, 3ème sèr., t. IX, 1873.

§ Note sur deux affleurements de Falun situés dans le voisinage du château du Thil. à Léognan (*Extrait des Procés-verbaux de la Soc. Linn. de Bord.*, 4 dec., 1895; Les Scalariidæ fossiles des Terrains Tert. sup. du Sud-Ouest (*Extr. des Actes de la Soc. Linn. de Bord.*, t. XLVIII).

** Defrenoy et Elie de Beaumont, Fossiles des faluns de Saucats, Merignac, Léognan, etc., Mém. pour servir à une désc. géol. de la France, t. III, p. 118, 1836.

Linder, Dépôts Lacustres du Vallon de Saucats, *Comptes rendus de l'excursion linniéenne à Saucats*, 1869.

Cossmann, Sur quelques formes nouvelles ou peu connues des faluns du Bordelais, *Ass. fran. pour l'Avancement des Sci.*, 1894-5.

by Mayer to the beds from the geographical name of this section in which the upper Oligocene is so typically developed.

In general the white and the grey limestones of Agen are of freshwater origin, while the sandstone of Bazas is marine. But to the westward, the limestones merge into marine beds.

White limestone of Agen. The white limestone of Agen, in the vicinity of Bazas, although a thin layer, is rich in freshwater fossils such as *Planorbis solidus*, *P. declivis*, *Limnæa pachygaster*, *L. urceolata* and *Helix*. Layers of clay and sand with a brackish fauna occur near Balizac, where *Lutraria sanna*, *Cyrena Brongniarti*, *Cytherea undata*, *Circe Deshayesi*, *Cerithium corrugatum*, *C. girondicum* and *C. plicatum* are also found.

Near Bordeaux the Aquitanian outcrops along a creek which flows through Saucats, Lariey and other hamlets. Tournouer, in 1862, described the lowest bed as a blue marl with *Neritina picta*, *Cerithium calculosum*, *C. plicatum*, *C. pseudothiarella* and *Lucina dentata*. But at the base is a freshwater layer with *Helix oxystoma* and *Planorbis cornu*. This indicates that the whole bed, though largely marine, represents the white limestone of Agen.

The blue marls, characterized by *Neritina picta*, are best exposed in a spring in a vineyard near La Salle (commune of La Brède). The owner obligingly dipped out a quantity of the fine, dark blue marl, which was found to be filled with this beautifully decorated species.

The sandstone of Bazas. The ferruginous sandstone of Bazas* is quarried in many localities as a building stone.

The fauna of this horizon is not varied. The most important species are *Scutella Bonali*, *Psammobia aquitanica*, *Ostrea producta*, *Mactra triangula*, *Arca cardiiformis*, *Turritella Desmaresti*, *T. vasatensis*, *Proto Basteroti*, *Monodonta Araonis* and *Cerithium plicatum*. These fossils usually are found only as internal casts, but, in a few localities, as at Balizac, the shells are well preserved.

The grey limestone of Agen. The grey limestone of Agen, near Brazas, is a thin deposit characterized by *Planorbis* and

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* Degrange-Touzin, Notes Géol. sur le Bazadais, *C. R. des Séances de la Soc. Linn. de Bordeaux*, vol. XLII, 1888, pp. 1-49.

Limnæa. Usually the bulk of the limestone has been much reduced by subsequent erosion. Like the white limestone, although generally of freshwater origin, it comprises also local brackish and marine beds.

Near Bordeaux, the grey Agen limestone is represented in part by the Saucats limestone. Fossils in this are rare. M. Benoist has found *Planorbis solidus*, *P. declivis*, *Helix subglobosa* and other species. The surface is bored by *Pholas*. According to Benoist, the Saucats limestone is the only representative in the Saucats valley of the grey limestone of Agen; but Tournouer, Linder and Fallot include also as equivalents, the shell-marl of Lariey and the freshwater clayey limestone of the Saucats valley.

The shell-marl of Lariey. The shell-marl of Lariey is a very compact, yellowish marl, best observed in an abandoned pit which is not far from the hamlet of Lariey. *Cerithium plicatum*, *Cytherea undata*, *Calyptrea sinensis* and a number of other species were obtained in abundance by the writer from this locality.

Limestone of Le Son. At Le Son, on a ploughed field, a large number of *Cerithium corrugatum* and *Lutraria sanna* were collected. This locality illustrates well the difficulty of correlation in the Bordelais, as on the neighboring field at the same level, are Miocene fossils, and the stratigraphic relations are not revealed by natural sections. This difficulty is increased by the change of beds laterally and vertically from freshwater to marine faunas.

Oligocene of the Adour valley. In the valley of the Adour, the Oligocene outcrops in the vicinity of Dax, St. Paul, St. Sever and on either side of the river between St. Avit and Roquefort. Originally these outcrops were very rich in fossils, but now the supply is exhausted. Fortunately there is a fine collection of types and specimens from the Adour valley in the museum of the University of Bordeaux.

Correlation of the Adour marls. The oldest publication on the basin of the Adour was by Palassou,* in 1784. This contains, however, practically no mention of fossils. Grateloup,[*] from 1834-40, described a large number of species from the Adour marls. In the publication in 1840,[†] in which he figures the species previously described, he notes the Yellow, Blue and White marls of the Adour valley, and refers the White to the Eocene (calcaire grossier) of the Paris basin, the Blue to the lower Miocene and the Yellow to the upper Miocene. In 1855, Delbos[‡] correlated the White marls and the Adour limestone, which are both characterized by *Natica crassatina*, and a portion of the Blue marls with the *Asterias* limestone of the Gironde valley and with the Fontainebleau sands.

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* *Essai sur la minéralogie des monts Pyrenées*, Paris, 1784.

Hébert[||] found further proofs of the parallelism of the Adour marls, with *Natica crassatina*, and the Fontainebleau sands.

Nummulites in the Blue marls. Tournouer[§] called attention, in 1863, to the remarkable abundance of *Nummulites*, especially the species *intermedia*, in the Blue marls of the Adour valley. This is of interest as compared with their rarity in the neighboring valley of the Garonne and with their abundance in the northern Italian basins.

Affinities of the Adour fauna. In general, the fauna of the Oligocene of the Adour is, like that of the Gironde, more closely allied to the species of the Italian deposits, and has but few forms in common with the equivalent beds of the Paris basin.

Oligocene of the Central Plateau. Both lower and upper Oligocene are developed in the southeastern part of the Plateau.

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[*] Tableau des coquilles fossiles des terrains tertiaires des environs de Dax, *Actes de la Soc. Linn. de Bordeaux*, t. VI-VIII; Monographies des coquilles tertiaires du bassin de l'Adour, *Ibid.*, t. X, 1838, et t. XI, 1840.

[†] *Conchy. Fossile des Terr. Tert. du Bassin de l'Adour*, Atlas, 1840.

[‡] Notice géol. sur les terr. du bassin de l'Adour, *Bull. de la Soc. Géol. de Fr.*, 2ème sér., t. IV, p. 712, 1847; Essai d'une désc. géol. du bassin de l'Adour, *Mém. des Sci. phys. et nat. de Bordeaux*, t. I, Jan., 1855; Notice sur les faluns du sud-ouest de la France, *Bull. de la Soc. géol. de France*, 2ème sér., t. V, p. 417, 1848.

[||] *Bull. Soc. Géol. Fr.*, 2ème sér., t. VI, p. 466, 1849.

[§] Note sur la presence des Nummulites dans l'étage à *Natica crassatina* du bassin de l'Adour, *Bull. Soc. Géol. de Fr.*, t. XX, 2ème ser., 1862-3, p. 649.

Fontanne's section. M. Fontanne,* in 1884, made the following section of this region:

5. Conglomerate.
Aquitanian. 4. Grey clays and limestone of Salindres. (*Cyclostoma antiquum* and *Rhinoceros*).
3. Calcareous sandstone (plants).
Tongrian. 2. Limestone of Montredon (*Planorbis* and *Limnæa*).
1. Limestone and marls of Monteils (*Cyrena semistriata*).

In the northwestern part of the Plateau, near La Limagne and Montbrison, are brackish and freshwater beds. The former mark the period during which the basins in which they rest were connected with the Paris basin; the latter are isolated deposits of lacustrine origin.

In the eastern portion of the Plateau, in the vicinity of Velay, freshwater limestones with *Planorbis* and *Limnæa* overlie the Eocene.

Oligocene of the Saône and Rhone valleys. Freshwater Oligocene beds, usually limestones, with *Helix Ramondi*, are well developed along the valley of the Saône, as at Dijon, Brognon and Belfort. In Languedoc, in the southwestern portion of the valley of the Rhone,† are upper Oligocene marine and brackish clays with *Potamides*.

Section of the Oligocene of the Mainz basin. The Oligocene of the Mainz basin consists of:

8. Limestone (*Corbicula Faujasi*).
7. Limestone (*Cerithium cinctum*, *C. plicatum*, *Potamides Lamarcki*).
6. Sandstone (imprints of leaves of *Quercus*, *Ulmus*, etc.).
5. Freshwater and brackish clays (*Cyrena semistriata*, *Cerithium plicatum*, *Potamides Lamarcki*, *Planorbis cornu*, *Anthracotherium alsaticum*).

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* Déscription sommaire de la malacologie des formations saumâtres et d'eau douce du groupe d'Aix, 1884.

† Fontanne, Études stratigraphiques et paléontologiques pour servir a l'étude de la période tertiaire dans le bassin du Rhone, 1875-1881.

4. Marine sands of Elsheim (*Pectunculus obovatus*, *Avicula Stampinensis*, *Cythereæ incrassata*).
3. Septaria clays (*Natica crassatina*, *Leda Deshayesiana*, *Cytherea splendida*).
2. Marine sands of Alzey and Weinheim (*Natica crassatina*, *Pectunculus obovatus*, *Cerithium Boblayei*).
1. Oyster beds (*Ostrea cyathula*, *O. callifera*).

In 1806, Faujas de Saint-Fond described the fossils of this basin.* This monograph was followed by those of Braun,† Weinkauff,‡ Sandberger|| and Lepsius.§ The recent work of Lepsius is of special value for both paleontological and stratigraphical reference.

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* Des coquilles fossiles des environs de Mayence, *Ann. du Muséum*, t. VIII, p. 372, also in-4°, Paris, 1806.

† Darstellung der geol. Verhältnisse des Mainzen Tertiärbeckens u. seiner fossilen Fauna u. Flora, in *Walchner's Geognosie*, 1850.

‡ Septarienthon im Mainzer Becken, *N. Jahrt. Mineral.*, p. 177, 1860.

|| Die Conchylien d. Mainzer Tertiärbeckens, Wiesbaden, in-4°, 460 pp., 36 pl., 1863.

§ Das Mainzer Becken, Darmstadt, 1883.

PART II.

THE OLIGOCENE OF THE SOUTHERN UNITED STATES.

General Extent.

The extent, as now determined, of the Oligocene in the Southern States is shown on the map on the opposite page.

The Vicksburg limestone. North of the large area of Vicksburg limestone, which passes through Georgia, dips into Florida, and, crossing Alabama and Mississippi, ends in the Vicksburg bluff, are isolated outcrops of the same rock noted by Prof. Harris. Their position in surrounding Eocene recalls the similarly situated Oligocene areas of Ecouen and Montmorency in the Paris basin. That these are remnants that have resisted the erosion which has removed the rest of the original northern extension of the present Vicksburg sheet is more than probable. They indicate that the limestone formerly extended at least as far north as Macon and Montgomery and to the north of Jackson. The most western exposure of Vicksburg is north of Harrisonburg, Louisiana, in the vicinity of Rosefield.

The southward extension of this limestone, as surface rock, is not great, since its extent is concealed beneath later deposits and the waters of the Gulf of Mexico. Borings at St. Augustine have shown that the Vicksburg has there a depth of 1,066 feet. The indications are that the entire peninsula of Florida rests upon a plateau* of this limestone, which formerly extended continuously to Cuba and the Bahamas, but has since been dissected and channeled by the erosive action of the Gulf Stream.

Chattahoochee limestones and clays. The Chattahoochee argillaceous limestones and clays are chiefly developed in Florida and in southern and southeastern Georgia. They also extend a trifle beyond the western state line of Florida and Alabama.

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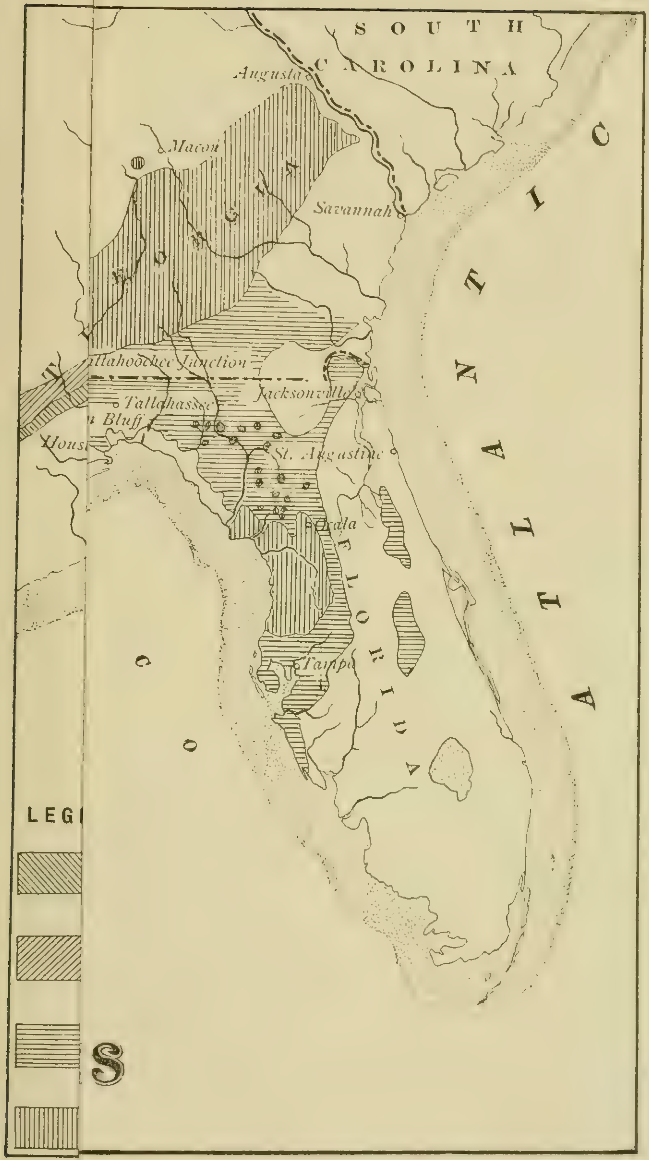
* Dall, *Bull. U. S. Geol. Survey*, No. 84, p. 181.

Tab. Pl. 25


SOUTH CAROLINA
Augusta
Macon
GEORGIA
Savannah
ATLANTIC
Chattahoochee Junction
Jacksonville
Tallahassee
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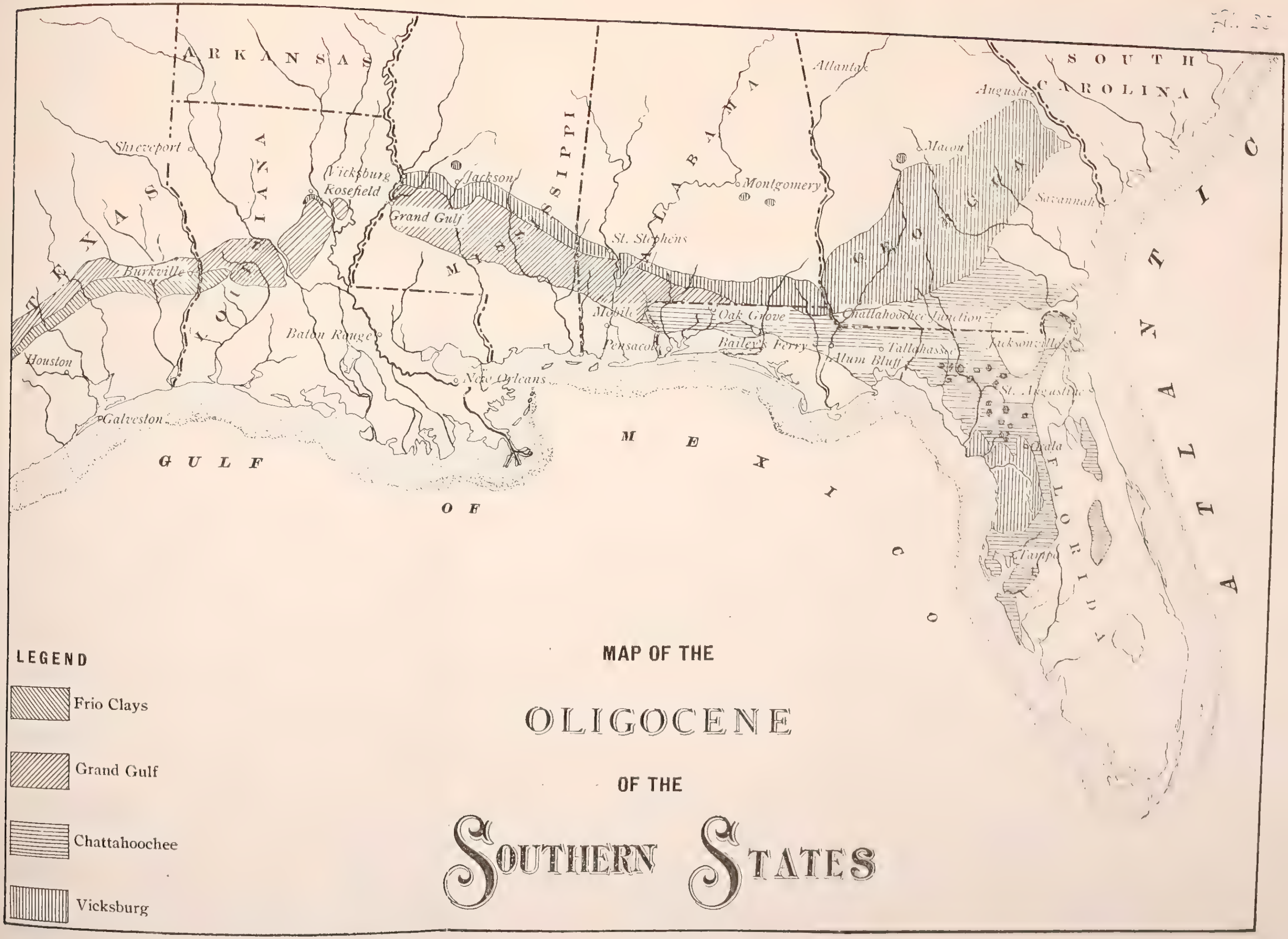
ARKANSAS
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TEXAS
LOUISIANA
MISSISSIPPI
ALABAMA
GEORGIA
FLORIDA
ATLANTIC
GULF OF MEXICO
Atlanta
Augusta
Macon
Savannah
Shreveport
Vicksburg
Rosefield
Jackson
Montgomery
Grand Gulf
St. Stephens
Burkville
Mobile
Oak Grove
Chattahoochee Junction
Jacksonville
Baton Rouge
Pensacola
Bailey's Ferry
Tallahassee
Alum Bluff
Houston
New Orleans
St. Augustine
Galveston
Ocala
Tampa

LEGEND

▧ Frio Clays

▨ Grand Gulf

☰ Chattahoochee

▥ Vicksburg

MAP OF THE
OLIGOCENE
OF THE
SOUTHERN STATES

Grand Gulf sandstones. The Grand Gulf sandstones first appear in southern Alabama near the center of the state along the Florida line. They widen rapidly beyond the western limits of Florida and extend to the Mississippi, forming the bluff at Grand Gulf. Beyond the Mississippi they reappear in Louisiana, at Sicily Island, and again near Harrisonburg. Crossing the state from that locality in a southwesterly direction, the sandstones enter Texas and extend certainly as far as the Brazos river.

Frio clays. The Frio clays are characteristic of Texas, but they extend eastward into southwestern Louisiana where they thin out and disappear.

Conditions of Deposition.

Physical Geography during the Vicksburg period. While the deposition of the Vicksburg limestone was taking place over a wide area of the sea-floor, the waters of the Gulf of Mexico and of the Pacific Ocean were probably confluent across the Isthmian region, as Mr. Alexander Agassiz has shown. Florida was at first entirely submerged. At the close of the period, islands near Ocala were upraised, as Dr. Dall has proved by the presence of land shells in the Ocala limestone. The southwestern extremity of the continent at the beginning of the Vicksburg period was, presumably, near the present sites of Macon and Augusta.

Deflection of the equatorial current. At the close of the Eocene, an elevation of the Isthmian region took place which cut off the Gulf of Mexico from the Pacific Ocean. The equatorial current, that had formerly swept across into the Pacific, was deflected to the north and northeast, along the shores of the continent. The shore line was upraised, exposing a portion of the Vicksburg limestone. Florida appeared as a chain of islands. The return current, as Dr. Dall has shown, passed between these islands and the shores of the continent through a broad strait for which Dr. Foerste proposes the name of Okefenokee,* as it occupied, in part, the region of Okefenokee swamp between southern Georgia and

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* Chipola Miocene, *Amer. Jour. Sci.*, 3rd ser., vol. 46, 1893, p. 245.

Florida. Dr. Foerste surmises that this strait was at first compartively shallow, but was scoured out by the erosive action of the current.

Depositions in the Chattahoochee and Mississippi embayments. Meanwhile, the Chattahoochee river brought down sediments which were mingled with shells along the shores and with material brought by the ocean current, and its embayment* was the principal scene of deposition of the Chattahoochee limestones and clays.

In a similar manner, the Grand Gulf deposits were made in the Mississippi embayment. The latter depositions, then, as now, were singularly lacking in organic remains.

Tropical fauna of Chipolan waters. The warm current bathing the shores made the Chipola period most favorable for molluscan life. Species introduced by this current from the Antillean waters† established thriving colonies.

Intrusion of cold current. Introduction of Chesapeake species. The continued elevation, however, gradually resulted in the deflection eastward and off-shore of the warm current, allowing the passage alongshore of a cold current from the northeast. Dr. Foerste‡ supposes the cold current to have branched at the southeastern extremity of the continent; one portion flowing past the Florida islands, and the other bathing the continental shores. This change was followed by the disappearance of the Chipola fauna, and the cold water fauna of the Chesapeake Miocene was introduced.

Dr. Dall notes|| the reappearance of the tropical Chipola forms under the more favorable conditions of the Pliocene of the Caloosahatchie.

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*Johnson, the Chattahoochee Embayment, *Bull. Geol. Soc. Amer.*, vol. 3, 1892, pp. 128-132.

†Dall, *Bull. U. S. Geol. Survey*, No. 84, 1892, p. 30.

‡*Amer. Jour. Sci.*, 3rd ser., vol. 46, 1893, p. 246.

||Dall, *Bull. U. S. Geol. Survey*, No. 84, 1892, p. 30.

The Oligocene Series in Detail in the Several States.

Florida.

Vicksburg Group. Vicksburg limestone. Orbitoides limestone, with characteristic Vicksburg fossils, forms a large part of the country rock of northern central Florida. The exact distribution is not yet definitely known, because the lithological differences of the Vicksburg and later limestones are so trifling that a faunal study is necessary to distinguish them. The rocks throughout the state are also much obscured by the dense sub-tropical vegetation and by superficial sands. The distribution of the Vicksburg in Florida, based on recent investigation by Dr. W. H. Dall* and others in that state, is sketched on the accompanying map, opposite page 42. In 1850 and 1851, Prof. J. W. Bailey described† this rock as a white Orbitulite limestone observed between Palatka and Tampa. Recent investigations show that it extends south nearly to the Hillsboro river. To the north it occurs in the region of Gainesville and Ocala, but, at these localities it is surrounded by extensive Chattahoochee deposits. At Ocala, the Orbitoides limestone was bored into for 350 feet, and its base not reached. At St. Augustine, as already noted, where this rock lies 212 feet below the surface, borings passed through 1,066 feet of the limestone without reaching the base.

Lithologically, the Orbitoides limestone is a porous rock of varying purity. It is usually rather soft when quarried, but hardens on exposure to the air. Certain strata are often rendered cherty, or even changed to pure flint, by the infiltration and deposition of silex in solution. Others are transformed to gypsum by the action on the calcium carbonate of water with sulphur, derived from decaying vegetation, in solution. An analogous chemical action results in the formation of phosphatic beds. The later limestones in the state are also subject to these modifications to a greater or less degree, dependent on the purity and solubility of the rock. Underground drainage and its attendent results, such as sink holes, the disappearance of surface rivers, temporary lakes and natural bridges, are characteristic of the limestone areas.

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* *Loc. cit.*, pp. 156-7.

† *Amer. Jour. Sci.*, 2nd ser., 1851, vol. 2, p. 86; *Smithsonian Contr. Knowl.*, 1850, vol. 2, No. 8, p. 19.

The fauna of the Orbitoides rock comprises many of the characteristic Vicksburg species such as *Orbitoides mantelli*, *Pecten poulsoni* and *P. perplanus*. As in the Gulf States, a large part of this limestone is formed wholly of the remains of *Orbitoides*.

Ocala nummulitic limestone. In the vicinity of Ocala, a yellow, friable limestone, containing nummulites, rests upon the Orbitoides rock. Quarries at Ocala have exposed some twenty feet of the nummulitic limestone without reaching the base. The area of surface exposure is limited, extending from Ocala almost to the coast. These beds were first described by Prof. John Le Conte.* He writes, "The whole of this portion of the peninsula appears to have been originally composed of a mixture of sand and shell limestone, probably of the Eocene period. The limestone comes to the surface almost everywhere; in some cases it is composed of nearly pure carbonate of lime ,in others silicification has taken place. But, in all cases where its structure can be made out, it consists of a mass of conglomerate shell."

T. A. Conrad,† in 1865, identified *Globulus alveatus* Con., *Venericardia prima* Con. and *Dosiniopsis alta* Con. from specimens of Ocala limestone. He remarks that these are all Eocene species of California, Maryland and New Jersey, and refers the Ocala rock to the period of the Shark River marl of New Jersey. The fauna is now found also to include a number of species occurring in the Tampa and Chipola beds, but a greater number are common to the Orbitoides limestone of which Ocala is a slightly later phase. The Ocala limestone was first distinguished from the Orbitoides rock by Prof. Heilprin. In 1862, masses of rock containing foraminiferal remains were found by Mr. Willcox on the Cheeshowiska River. The species was identified by Prof. Heilprin as a true nummulite, the first of the genus found in

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*Optical Phenomena of the Silver Spring, *Amer. Jour. Sci.*, 2nd ser., vol. 31, p. 11.

†*Proc. Acad. Nat. Sci.*, Phila., 1865, p. 184.

America, and named by him, *Nummulites Willcoxi*.[*] He found later another species of the same genus, *N. floridensis*, which is less common than the former. The fragments of nummulitic rock were bordered by a fringe of Pleistocene limestone with recent freshwater shells indicating that the older deposit had been worked over, but the latter was subsequently found in place 15 miles from the original locality, and has since been observed in several places and identified with the Ocala limestone. The existence of Nummulitic beds in the United States was thus definitely established by Prof. Heilprin.[†] At Wheelers, on the Homosassa River, a few miles from the Nummulitic beds, Prof. Heilprin found a tough, horizontal limestone, full of *Miliolidæ*. The near association of the miliotitic and nummulitic beds leads Prof. Heilprin to consider them almost equivalent.

Beds analogous to the nummulitic deposits of central Florida have been found silicified at Hawkinsville, Georgia, and on the Suwanee river in Florida.[‡]

Chattahoochee Group. Langdon's discovery of the Chattahoochee beds. In 1887, Mr. D. W. Langdon discovered on the Chattahoochee River, beneath the Orbitoides limestone, a formation which he described as an "argillaceous and sandy limestone, alternating with strata of purer character. Contains a *Pecten* and an *Ostrea* very close to our recent *Virginica*. This may be termed the Chattahoochee group, as it is well developed there, and along the eastern river bank for the next ten miles."[||]

This deposit first appears nine miles above Chattahoochee Junction and continues in sight to Rocky Bluff, where it disappears. After Mr. Langdon's discovery of the Chattahoochee group, beds belonging to this series, but previously confused with the Orbitoides limestone, were found to extend not only over the greater part of northwestern Florida, but also to form, in part, the country rock of the central portion of the peninsula. The extent of the Chattahoochee is indicated on the map.

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[*] Occurrence of Nummulitic deposits in Florida, *Proc. A. N. S.*, July, 1882. (Species described earlier by Morton and Conrad as belonging to the genus *Nummulites* were really *Orbitoides*).

[†] Explorations West Coast of Florida, *Trans. Wag. Free Inst. Sci.*, vol. 7, 1887.

[‡] Dall, *Loc. cit.*, p. 105.

[||] Geoligical Section Chattahoochee River, in *Geol. Survey Ga.*, 1890-91, also *Amer. Jour. Sci.*, 3rd ser., 1889, vol. 38, p. 324.

The Orbitoides and Chattahoochee limestones vary in their surface characteristics, but the difference is only one of degree. The Chattahoochee is much less porous, denser, more argillaceous and, hence, less soluble than the Orbitoides. As a result, the drainage in the Chattahoochee areas is more on the surface instead of underground, as in the older limestone areas. The more variable beds of the Chattahoochee rock also gives rise to a more rugged topography, which forms a contrast with the level Vicksburg areas.

The Chattahoochee series in central Florida. The Hawthorne beds. In 1887, Dr. Dall described* certain beds of broken-up phosphatic rock, enclosed in a younger matrix, found overlying the Vicksburg group in the vicinity of Gainesville. Beds of the phosphatic rock were later found in place on hilltops near Archer. Dr. Dall has named them the Hawthorne beds, since they are quarried at that town. They usually comprise a greenish clay at the top, followed by ferruginous gravel and phosphatic oolite. The Hawthorne beds constitute the base of the Chattahoochee group in central Florida.

The Orthaulax bed. Dr. Dall proposes the name Orthaulax bed† for the siliceous outcrop on the shores of Tampa Bay, which has been generally called the Tampa silex bed. The original limestone has been much modified by the infiltration and decomposition of silex and, locally, by disintegration into marls. The deposit extends up the Hillsboro and Manatee Rivers. It was observed at the Falls of the Hillsboro River, in 1846, by Lieut. John H. Allen, who described‡ it as a dark, siliceous rock, noted for the beauty of its chalcedonized fossils. He distinguished clearly between this rock and the overlying Tampa limestone, while Conrad's description* in the same year is obscure in this respect.

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* *Loc. cit.*, p. 108; see also *Amer. Jour. Sci.*, 3rd ser., 1887, vol. 34, p. 164.

† *Ibid.*, p. 107.

‡ Geology of Tampa Bay, *Amer. Jour. Sci.*, 2nd ser., vol. 1, 1846, pp. 38-42.

Prof. Heilprin† speaks of a siliceous rock at Ballast Point, containing quantities of *Cerithium*. But Dr. Dall‡ subsequently found that the true siliceous rock does not contain *Cerithium* (*hillsboroensis*) and thinks the stratum mentioned by Prof. Heilprin was probably a cherty layer of the Tampa limestone, overlying the Orthaulax bed.

Bailey's infusorial earth. Prof. J. W. Bailey,‖ in 1850, found in the vicinity of Tampa Bay an infusorial layer which he compared with similar beds in Virginia. Dr. Dall, in 1891, observed this bed near Ballast Point, and found it to be a siliceous marl, formed by local decomposition of the original Orthaulax beds. In the samples examined microscopically, no infusorial remains were found.§

White Beach sand rock. The White Beach sand rock of Little Sarasota Bay is a waterworn limestone, covered with superficial recent layers of sand. The fauna resembles that of the Orthaulax bed, and also contains species of the Chipola marls.**

The Tampa limestone. The Tampa limestone which outcrops along the shores of Tampa Bay, underlies the city of Tampa, and extends to the Hillsboro and Manatee Rivers, was referred until recently to the Vicksburg period. An outcrop of this rock at Fort Brooke, Tampa Bay, was described by Lieut. J. H. Allen†† in 1846, as a white limestone, typically hard, but with occasional softer beds. Over wide areas it retains its general lithological characteristics. The country which it underlies is characterized by sink holes and subterranean streams. Many lakes and ponds in the interior rest upon the limestone. At certain localities the deposit is fossiliferous.

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* *Ibid.*, vol. 2.

† Explorations West Coast, *Trans. Wag. Free Inst. Sci.*, vol. 1, 1887.

‡ *Loc. cit.*, p. 107.

‖ *Amer. Jour. Sci.*, 2nd ser., vol. 10, p. 282; also *Microscop. Obs. Smithsonian Contr. Knowl.*, 1850, vol. 2, No. 8, p. 19.

§ *Loc. cit.*, pp. 116-7.

** *Loc. cit.*, p. 114.

†† Some Facts respecting the Geol. of Tampa Bay, *Amer. Jour. Sci.*, 2nd ser., vol. 1, 1846, pp. 38-42.

Referred by Conrad to the Upper Eocene. In the same year, T. A. Conrad* visited the region and traced the limestone from Fort Brooke to the Hillsboro and up the Manatee. He concluded that the rock extends throughout the peninsula as far south at least as Tampa Bay. He remarks that the fossils bear no resemblance to either Miocene or Eocene species, but that the formation will probably prove to be an upper member of the Eocene. Eight species from the Tampa limestone at Ballast Point were described by Conrad† a short time later. Among these is *Bulimus floridanus*, which he notes as the first fossil land shell found in American Tertiaries. The other species are all marine, and include *Nummulites floridanus*, *Bulla petrosa*, *Nucula tellinula*, *Cytherea floridana*, *Venus penita* and *V. floridana*.

The basal layers of the Tampa limestone contain few fossils, but, in the upper beds, *Natica amphora* and *Venus penita* are said by Dr. Dall to be very common. Lithodomus borings characterize the upper surface.

Correlated with the Vicksburg formation. The occurrence of the foraminifer described as *Nummulites floridanus* led Conrad to correlate the Tampa with the Vicksburg limestone, since the latter contained a species described by Morton as *Nummulites mantelli*, and was called the American Nummulitic formation.‡

Prof. Tuomey|| explored the Florida coast in 1850, and agreed with Conrad that the limestone of Tampa and Fort Brooke represents an older Tertiary deposit.

The Coralline theory of Agassiz and Le Conte. Disregarding

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* Obs. on the Geol. of a part of East Florida, *Ibid.*, vol. 2, pp. 36-48.

† Descriptions of new species of organic remains from Upper Eocene Limestones of Tampa Bay, *Ibid.*, vol. 2, pp. 399-400.

‡ Both these generic determinations were later shown to be erroneous, and Prof. Heilprin described the first true nummulite found in this country in 1884.

|| Notice of the Geol. of the Florida Keys and the Southern Coast of Florida, *Amer. Jour. Sci.*, 2nd ser., vol. 11, pp. 390 ff.

the conclusions of the preceding geologists, Prof. Agassiz, after a visit to Florida in 1861, pronounced the country rock to be a recent coralline formation.[*] In his monograph on the reef, Prof. Agassiz speaks of his surprise and delight at finding that the solid foundation of the mainland consists of the same identical modifications of the coral rock which form the keys.

Prof. Joseph Le Conte expounded the coralline hypothesis with such skill that, for thirty years, it remained the established theory. He remarks[‡] that Florida has been thought to consist of the southward prolongation of the Georgia and Alabama Eocene, and its shell limestone to bear a general resemblance to the White Limestone. It is, however, a remarkable fact that most of the peninsula and the keys are of recent origin, the work of corals still living in the vicinity. Whether any Eocene beds occur at Tampa is still problematic.

Coralline theory refuted by Smith in 1881. The observations of Mr. E. A. Smith, in 1881, compelled Prof. Le Conte[‡] to modify this view, and, in 1883, he limited the area of coralline formation to the region south of the Everglades.[||]

Mr. Smith[§] traced the Vicksburg limestone by outcrops from Jackson County in northwestern Florida to a point below Ocala. Since Conrad and Tuomey had found in the Tampa region limestone which they referred to the Vicksburg, Mr. Smith concludes that "almost the whole State of Florida from the Perdido River on the west, eastward and southward, including the middle and western parts of the peninsula, certainly as far south as the latitude of Tampa Bay, and probably, as far south as the latitude of Charlotte Harbor, has, for its underlying formation, the white

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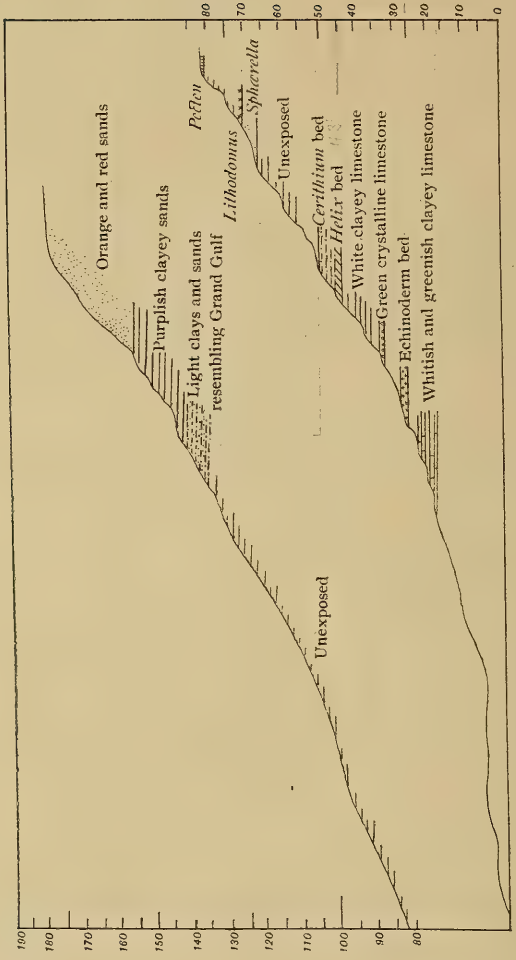
[*] Report on the Florida Reefs, *Mem. Mus. Comp. Zool.*, 1880 (pub. by Alex. Agassiz).

[†] On the Agency of the Gulf Stream in the Formation of the Peninsula and Keys of Florida, *Amer. Jour. Sci.*, 2nd ser., vol. 23, pp. 46 ff.

[‡] *Science*, Dec. 14, 1883.

[||] The coral area is now considered as comprising only the border region on the south and southeast of the peninsula. The coral beds in Tertiary times were evidently sporadic and did not form any extensive reefs.

[§] The Geol. of Florida, *Amer. Jour. Sci.*, pp. 292 ff.


Orange and red sands
Purplish clayey sands
Light clays and sands
resembling Grand Gulf
Unexposed
Pecten
Lithodomus
Sphærella
Unexposed
Cerithium bed
Helix bed
White clayey limestone
Green crystalline limestone
Echinoderm bed
Whitish and greenish clayey limestone
80
70
60
50
40
30
20
10
0
190
180
170
160
150
140
130
120
110
100
90
80

SECTION AT OLD CHATTAHOOCHEE LANDING.

or Orbitoides limestone of Vicksburg age.*

Much of the limestone referred by Mr. Smith to the Vicksburg has proven of somewhat more recent formation, but he refuted the coralline theory by proving the existence of Tertiary deposits on the peninsula.

Tampa limestone referred by Heilprin to the Santo Domingo Miocene. Prof. Heilprin,† in 1887, referred the Tampa limestone to the Miocene because he found a close resemblance between the species of the Florida rock and those of the Santo Domingo Miocene beds. During the same year, Dr. Dall also noted this affinity of the fauna of the Tampa limestone and that of the Antillean Miocene.‡

The Chattahoochee series in northwestern Florida. Section at Old Chattahoochee Landing (*see page 52*). A number of sections were made at various bluffs along the Appalachicola River by Prof. Harris in 1901. Of these sections, the most northern was taken at Old Chattahoochee Landing, about one mile above the railroad bridge, on the eastern side of the river, following the road from Rena Harding's ferry to Chattahoochee village. The lower portion, from the base up to 83 feet, was run with a Dumpy level, the upper portion by Locke level. The river surface was about 23½ feet below the railroad rails when the section was made. From this level as a base, the height of the bluff was found to be 178 feet.

The rocks of the Chattahoochee series in this locacity are all light colored, and often poorly consolidated. The greenish layers are commonly soft clays, but even these are harder than the majority of the white beds. A layer with Helices was noted by

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* To explain the absence, according to this theory, of Grand Gulf deposits in Florida, Mr. Smith suggests that the western coast line of the Eocene peninsula was much to the westward of the present shore line, and that the Grand Gulf deposits are now submerged, as is indicated by the submarine shelf extending far out into the Gulf of Mexico.

† Exploration of the West Coast of Florida, *Trans. Wag. Free Inst. Sci.*, vol. 1, 1887.

‡ Notes on the Geol. of Florida, *Amer. Jour. Sci.*, 3rd ser., 1887, vol. 34, pp. 161-170.

Prof. Harris at an elevation of about 43 feet. The presence of these land shells recalls the mixed fauna of the Tampa and Ocala beds, and, as there, presumably indicates an increase of neighboring land areas.

A number of fossils were obtained, chiefly from the Echinoderm, *Cerithium*, *Lithodomus* and *Pecten* beds, but nearly all in the form of casts. Among these are *Conus* cf. *planiceps*, *Cerithium*, *Ampullina* cf. *amphora*, *Ostrea*, *Loripes*, *Pecten* (2 species), *Modiolus*, *Lithodomus*, *Hemicardia*, *Gastrochæna*, *Divaricella* and Echinoderms. It is of interest to compare this section with one taken in the near vicinity by Dr. Dall* in 1895. In the latter section the fossiliferous zone was limited to four feet; while in the former, fossils were found at intervals through a depth of fifty-seven feet, the principal fossiliferous layers being the *Pecten*, *Sphærella*, *Cerithium*, *Helix* and Echinoderm beds.

Section at Aspalaga Bluff (*see page 55*). A land leveled section was taken several miles south of Old Chattahoochee Landing, at the northern end of Aspalaga Bluff. At this point the total height above water level was found to be 155 feet.† Three principal fossiliferous zones were noted, the *Madrepora* bed, 26 feet from the base; a bed of whitish-yellow limestone at an altitude of about 32 feet, resting on the coralline bed and containing a quantity of small fossils; and a layer with casts at an altitude of 62 feet.

Above 84 feet the bluff is almost wholly covered. Limestone with *Pecten* and *Placuna*, at an altitude of about 145 feet was, noted *in situ* by Prof. Harris. This indicates that the limestone mentioned by Dr. Foerste as occurring 130 feet above water level was also in place, and not transferred as Dr. Dall suggests.‡

No real discrimination could be made, at least in the region of sectioning, between the so-called "Aspalaga clays" of Mr. Johnson‖

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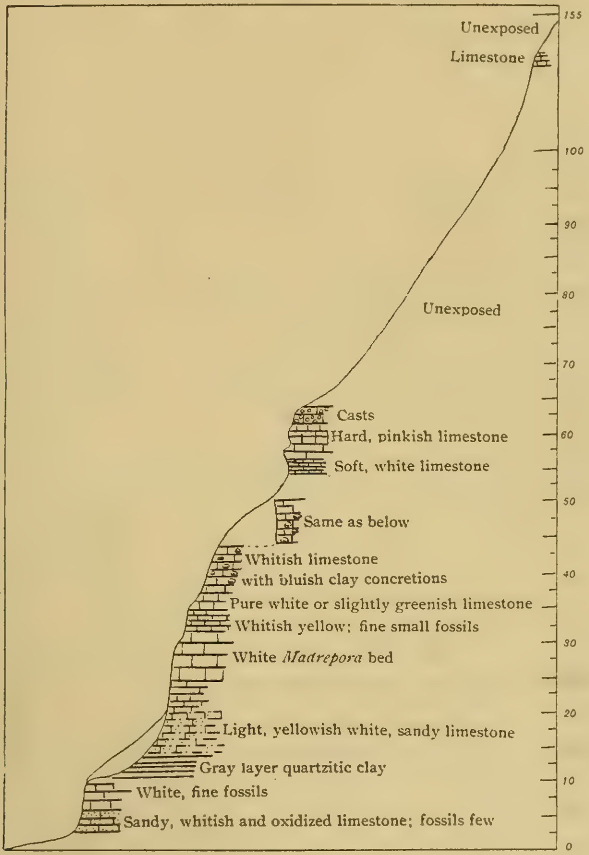
* Dall and Stanleo-Brown, *Bull. Geol. Soc. Amer.*, vol. 5, 1895, p. 152.

† The intervals from 10 to 20 and from 43 to 50 feet were covered with talus in the direct line of sectioning. The beds thus concealed were observed at one side of the line and are indicated in the section within the talus slopes.

‡ *Bull. Geol. Soc. Amer.*, vol. 5, 1895, p. 154.

‖ *Ibid.*, vol. 3, 1892, p. 129.


155
Unexposed
Limestone
100
90
80
Unexposed
70
Casts
Hard, pinkish limestone
60
Soft, white limestone
50
Same as below
Whitish limestone
with bluish clay concretions
40
Pure white or slightly greenish limestone
Whitish yellow; fine small fossils
30
White *Madrepora* bed
20
Light, yellowish white, sandy limestone
Gray layer quartzitic clay
10
White, fine fossils
Sandy, whitish and oxidized limestone; fossils few
0

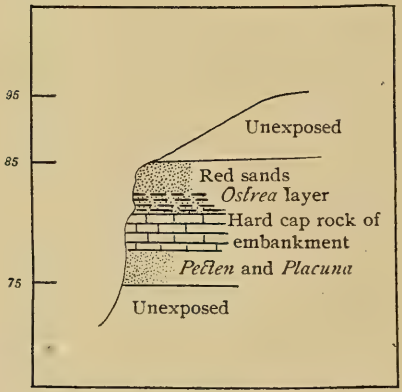
SECTION AT ASPALAGA BLUFF.

and the Chattahoochee limestone. The clays appear rather to be merely argillaceous beds of the limestone, which becomes again more calcareous above.

A section taken at the highest point of Aspalaga Bluff by Dr. Dall gives a total thickness of 75 feet above water level. Of this, the lower 40 to 50 feet are referred to Chattahoochee limestone; the succeeding 20 feet, to bluish green marl (Aspalaga clay of Johnson) with *Ostrea* and *Pecten;* the remaining five feet comprised reddish sands and gravels.

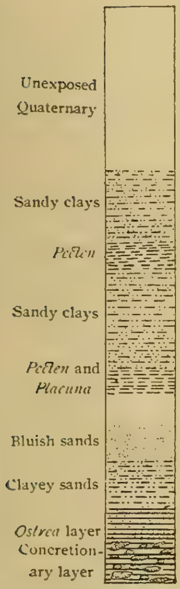
Dip of Coralline bed. About an eighth of a mile south of the northern end of Aspalaga Bluff, a small ravine enters the river valley. This ravine is the second passed in traversing the distance indicated. Up the ravine, the coralline (*Madrepora*) bed is but 15 feet above the level of the base assumed in the last section, instead of 25 feet as at Aspalaga Bluff, showing a southward dip of 10 feet to an eighth of a mile. Farther up the ravine, along the right hand fork, at a height of 135 feet above the same datum plane, the greenish-white, clayey limestone was found, containing *Placuna*, *Pecten* and two species of *Ostrea*, a large and a plicate form. The fossils range through 124 to 138 feet approximately. The same bed occurs at Aspalaga Bluff at a height of about 145 feet.

Section at Camp Scott. A mile or more above Ocheesee Landing, but on the eastern shore, a section was leveled by Mr. Pacheco. The total height of the bluff at this point was found to be 95 feet. Of this distance, the lower 75 feet and the upper 10 feet were unexposed. A fossiliferous, sandy layer with *Pecten* and *Placuna* was noted, extending from 75 to 78 feet, and an *Ostrea* bed from 81 to 83 feet, being separated from the *Pecten* bed by the hard limestone which forms the cap rock of the embankment. Above the *Ostrea* bed are red sands.

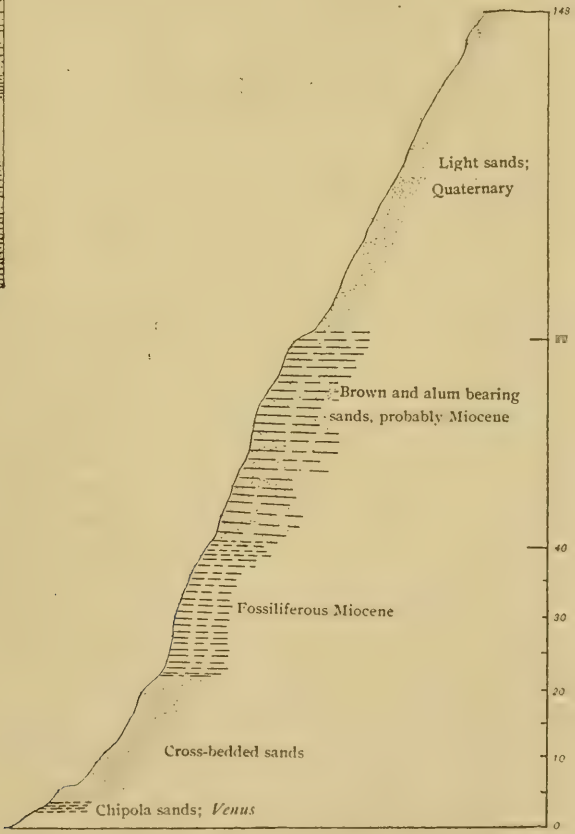


SECTION AT CAMP SCOTT.

Section at Rock Bluff (*see page 57*). A section was taken by Prof. Harris at Rock Bluff, a short distance south of Camp Scott. The total height of the bluff was found to be 90 feet above water level. The section shows the contact of a concretionary layer of


Unexposed
Quaternary
Sandy clays
Pecten
Sandy clays
Pecten and *Placuna*
Bluish sands
Clayey sands
Ostrea layer
Concretionary layer

SECTION AT ROCK BLUFF.
(Scale: 1 inch = 20 feet).


148
Light sands; Quaternary
Brown and alum bearing sands, probably Miocene
40
Fossiliferous Miocene
30
20
Cross-bedded sands
10
Chipola sands; *Venus*
0

SECTION AT ALUM BLUFF.

the Chattahoochee limestone and the overlying sandy clays (Aspalaga clays).

In the clays, at a height of about 30 feet, the base of a *Pecten* and *Placuna* bed was observed, and, separated from this by sandy clays, another *Pecten* bed was found at a height of about 50 feet.

Average dip of the Pecten and Placuna layer. If we suppose the layer containing *Pecten* and *Placuna* to be the same at Aspalaga, Camp Scott and Rock Bluff, we find a dip of 118 feet during the five miles between Aspalaga and Rock Bluff, or an average descent, southward, of 23 feet in a mile. That this dip is steeper toward the north is shown by the following rate of slope:

Aspalaga to the ravine,	⅛ mile,	10 feet,	or 80	feet	per	mile.
Aspalaga to Camp Scott,	2 miles,	70 "	" 35	"	"	"
Camp Scott to Rock Bluff,	3 "	48 "	" 16	"	"	"

The section of the bluff corresponds nearly with one made by Dr. Dall.* In the latter, however, a somewhat greater thickness is assigned to the limestones and clays.

Section at Alum Bluff (*see page 57*). At Alum Bluff, 3 miles below Rock Bluff, a section was also made. The total height of the bluff above water level at the time of sectioning was found to be 148 feet. The Chattahoochee limestone is no longer visible, and the fossiliferous Chipola sands, obscured in part by a talus, are found a few feet above the river. These sands are overlaid by some 19 feet of cross-bedded sands, constituting the Alum Bluff transitional beds, and underlying the fossiliferous Chesapeake Miocene. The section, in general, agrees with that of Dr. Dall.†

The Chipola marl. The Chipola marl is a compact mixture of broken shells, sand and clay. At Alum Bluff, the color of this deposit is dark red, owing to the presence of iron peroxide, but usually, at other localities, it is light yellow.

Chipolan species from Alum Bluff. The following species‡ have been identified in the material collected, under the direction of Prof. Harris, from the Chipola marls at Alum Bluff:

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* *Bull. Geol. Soc. Amer.*, vol. 5, 1895, p. 156.

† *Ibid.*, p. 157.

‡ For original descriptions and references, see Dall, *Trans. Wag. Free Inst. Sci.*, vol. 3, pts. 1-6.

+*Haminea pomphalyx* Dall.*
Dolabella Aldrichi Dall.
Terebra (*Acus*) *dislocata* (?) Say.
Drillia ostrearum Stearns.†
Clava chipolana Dall.
+*Olivella.*
+*Marginella.*
Turbinella chipolana Dall.
Fulgur spiniger Con.
Melongena sculpturata Dall, var.
Cypræa Willcoxi Dall.
Orthaulax Gabbi Dall.
Cerithium Burnsii Dall.
Turritella subgrundifera Dall.
" *terebriformis* (Con.) Dall.
Natica (*Cryptonatica*) *floridana* Dall.
Dentalium cardinense Con.
Ostrea sellæformis Con. var. *rugifera* Dall.
Pteria (*argentea* var. ?) *chipolana* Dall.
Modiolus cf. young of *curtulus* Dall.
Scapharca (*Anadara*) *campsa* Dall.
" *staminata* Dall.
Nucula chipolana Dall.
Carditamera recta Con., var. ?
Crassatellites densus (?) Dall.
Cardium (*Trigonicardia*) *alicula* Dall.
" *chipolanum* Dall.
Venus Burnsii Dall.
" *Langdoni* Dall.
Donax cf. *chipolanum*, var. *curtula* Dall.
Tellina chipolana Dall.
" (*Merisca*) *hypolispi* Dall.

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* Species marked (+) are identical with species in the Smithsonian collection awaiting description by Dr. Dall.

† *D. Ostrearum* Stearns, *Proc. Boston Soc. Nat. Hist.*, XV, p. 22, 1872.

The Chipola marls are also exposed at Bailey's Ferry, on the Chipola River, several miles west of Alum Bluff.

At McClellan's marl bed, Bailey's Ferry, Dr. Dall* observed the Chipola marl varying in depth from seven to twelve feet, resting on the Chattahoochee limestone at the water's edge.

Chipolan species from Bailey's Ferry. The marl at Bailey's Ferry contains a very rich fauna. Among the species, collected for the University at this locality, are the following:

Nautilus (fragments).
Vaginella chipolana Dall.
+*Tornatina*.
Terebra (*Acus*) *dislocata* Say.
Atys œdemata Dall.
Conus planiceps Heil.
+ " (3 species).
Pleurotoma albida Perry.
Drillia lunata Lea.
" *ostrearum* Stearns.
" (*lissotropis* var. ?) *perpolita* Dall.
+ "
Clava chipolana Dall.
+*Cythara*.
Cancellaria conradium Dall.
"
Oliva litterata Lam.
Olivella mutica Say.
+*Marginella* (4 species).
+ " (*Persicula*).
Lyria.
Mitra carolinensis Con.
+ " (2 species).
Conomitra staminea Con.
Latirus rugatus Dall.
Turbinella, young of *chipolana* (?).
" , like *ovoidea* Gabb.

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* *Bull. Geol. Soc. Amer.*, vol. 5, p. 159.

Vasum haitense Sow. var. *egonatum* Dall.
" cf. *subcapitellum* Heil.
Fulgur spiniger Con.
" *pyrum Dillwyn*, var. *incile* Con.
" *spiniger*, var. *spiniger* Con.
+*Phos.*
+*Nassa.*
+*Astyris.*
+*Strombina.*
Typhis linguiferus Dall.
Murex mississippiensis Con.
Coralliophila magna Dall.
Pyrula papyratia Say.
Erato near *lævis.*
Strombus Aldrichi Dall.
Orthaulax Gabbi Dall.
Cerithium Burnsii Dall.
Bittium (*Styliferina*) *boiplex* Dall.
" *chipolanum* Dall.
" " , var. *Burnsii* Dall.
" " Dall var.
" *Cossmannii* Dall.
" *permutabile* Dall.
" " " var.
Vermetus (*Petaloconchus*) *varians* d'Orb.
Serpulorbis ballistæ Dall.
" *decussata* Gmelin.
Turritella subgrundifera Dall.
" *terebriformis* (Con.) Dall.
Alaba chipolana Dall.
Rissoina chipolana Dall.
" *decussata* Montagu.
Almathea Willcoxi Dall.
Crucibulum auricula Gmelin, var. *chipolanum* Dall.
Crepidula plana Say.
Calyptræa centralis Con.
" *trochiformis* Lam.

Xenophora conchyliophora Born.
“ (*Turgurium*).
Natica (*Cryptonatica*) *floridana* Dall.
Ampullina amphora Heil.
“ “ (?) Heil.
Sigaretus chipolanus Dall.
+*Scala*.
+*Eulima*.
Astralium (*Lithopoma*) *chipolanum* Dall.
“ cf. sp. indet. Dall.
Chlorostoma (*exoletum* var. ?) *limatum* Dall.
Calliostoma (*Eutrochus*) *ceramicum* Dall.
“ *exile* Dall.
“ *grammaticum* Dall.
Fissuridea chipolana Dall.
Dentalium disparile d'Orb.
Ostrea haitensis Sow.
“ *trigonalis* Con.
Anomia microgrammata Dall.
Spondylus bostrychites Guppy, var. *chipolanus* (?) Dall.
Lima tampaensis Dall.
Pecten (*Chlamys*) *alumensis* Dall.
“ (*Aequipecten*) *chipolanus* Dall.
“ *condylomatus* Dall.
“ (2 species indet.).
Pteria argentea Con. var. *chipolana* Dall.
Mytilus, young specimen.
Lithodomus nuda Dall.
Modiolaria cf. sp. indet. Dall.
Arca (*Scapharca*) *hypomela* Dall.
“ *paratina* (?) Dall.
Barbatia (*Fossularca*) *Adamsi* (Shuttleworth) Smith.
“ *irregularis* Dall.
“ *marylandica* Con.
Scapharca hypomela Dall.
“ *staminata* Dall.
Pectunculus subovata Say, var. *plagia* Dall.

Nucula chipolana Dall.
Leda linifera Con., var. *chipolana* Dall.
Yoldia frater Dall.
Cardita (*Carditamera*) *recta* Con. var. (?).
Crassinella triangula Dall.
Crassatellites densus Dall.
Cardium (*Papyridea*) *bulbosum* Dall.
" *chipolanum* Dall.
" (2 species indet.).
+*Chama* (sp. indet.).
Venus Burnsii Dall.
" *Langdoni* Dall.
+ "
Donax cf. *chipolanum*, var. *curtula* Dall.
" var. of *chipolana* (?).
Siliqua subæqualis Gabb.
Solen cf. *amphistemma* Dall, (fragment).
Mactra chipolana Dall.
Spisula (*Hemimactra*) *dodona* Dall.
Corbula chipolana Dall.
" *heterogenea* (?) Guppy.
Panopæa Whitfieldi Dall.
Gastrochæna ovata Sow., var. *rotunda* Dall.
Miltha (sp. indet.).
Aligena pustulosa Dall.
Tellina (*Angulus*) *acosmita* Dall.
" cf. *flexuosa* Say.
Syndosmya triangulata Dall.
The locality of the following species is doubtful:
+*Drillia*.
Strombina eugrammata Dall, (ms.).
Murex mississippiensis Con.

The Alum Bluff beds. The Alum Bluff bed, so named by Dr. Dall in 1891, consist of light colored sands, cross-bedded, especially a few feet above the base. A number of Chipolan species have been reported from the lower part of the deposit. In the sands are occasional clayey layers, which, in the lower part of the deposit, contain fragments of palmetto and some dicotyledonous leaves, especially those of the willow. In the upper portion, the deposit appears to be unfossiliferous. Dr. Dall considers the Alum Bluff beds as a continuation* of the clayey sands (Aspalaga clays) at Rock Bluff and Aspalaga.

The Oak Grove sands. At Oak Grove, on the Yellow River, is a ledge of fine greyish sand, containing fauna of a transitional character. It contains some species not found in the Chipola marl, and has been correlated with the Alum Bluff beds by Dr. Dall.†

Species from the Oak Grove sands. Among the species collected at Oak Grove are:

Terebra dislocata Say, var. *indenta* Con.
Conus chipolanus Dall.
   " *planiceps* Heil.
+ "
Pleurotoma albida Perry, (*cochlearis* Con.).
   " *boadicea* (?) Dall.
Drillia ostrearum Stearns.
Cancellaria Conradiana Dall.
   " (young).
Oliva litterata Lam.
Turbinella Wilsoni Con.
Fulgur spiniger Con.
   " " ", var. *Burnsii* Dall.
Pseudoneptunea near *multangula* Ph.
+*Nassa.*
+*Coralliophila.*
Strombus chipolanus Dall.
Bittium (*Styliferina*) *boiplex* Dall.
   " *Cossmanni* Dall.
Vermetus varians d'Orb.
Serpulorbis granifera Say.
Turritella alcida Dall.
   " *subgrundifera* Dall.

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* *Ibid.*, p. 166.
† *Ibid.*, p. 166.

Turritella terebriformis Con.
Solarium (sp. indet.).
Crucibulum auricula Gmelin, var. *chipolanum* Dall.
Crepidula plana Say.
Calyptræa centralis Con.
Natica (*Cryptonatica*) *floridana* Dall.
Ampullina amphora Heil.
Sigaretus chipolanus Dall.
" (*Eunaticina*) *Conradii* Dall.
+*Neritina*.
Calliostoma (*Eutrochus*) *ceramicum* (?) Dall, (young).
Ostrea trigonalis Con.
Anomia floridana Dall.
Spondylus bostrychites Guppy, var. *chipolanus* (?) Dall.
Pecten Madisonius Say, var. *Sayanus* Dall.
Pinna quadrata (?) Dall, (fragment).
Modiolus curtulus (?) Dall, (young).
Arca (*Scapharca*) *dodona* Dall.
" " *santarosana* Dall.
Pectunculus subovata Say, var. *plagia* Dall.
Trinacria Meekii Dall.
Nucula sinaria Dall.
Yoldia frater Dall.
Crassatellites densus Dall.
Montacuta actinophora Dall.
Aligena lineata Dall.
Sportella lioconcha Dall.
Cardium (*Trigonicardia*) *apeteticum* Dall.
" *taphrium* Dall.
Venus Burnsii Dall.
Diplodonta radiata Dall.
Corbula radiatula Dall.
" *seminella* Dall.
Panopæa Whitfieldi Dall.
Gastrochæna (sp. indet.).
Lucina plesiolopha Dall.
Tellina (*Angulus*) *acalypta* Dall.

Tellina dodona Dall.
" (*Eurytellina*) *roburina* Dall.
Macoma tracta Dall.
+*Pandora*.

The following new species are in the Museum of Paleontology of Cornell University and not reported from the Smithsonian.

FASCIOLARIA Lamarck

Fasciolaria Ramondi sp. nov., Pl. 28, fig. 1

Shell of medium size, rather thin, eight-whorled. Nucleus small, smooth. Succeeding whorls with transverse peripheral ribs varying in number from eight to eleven. Ribs slightly less marked on the terminal than on the three preceding whorls. Entire surface covered with fine, transverse lines. Incremental lines irregular. Suture distinct on the later whorls, which are flattened beneath it. Spiral sculpture of threads, usually alternating in strength, and covering the entire surface. Canal one-fourth the entire length of the shell. Aperture elliptical. Callous thin. Plaits on columella well marked within. Outer lip thin, crenulated where perfect, compressed near the suture. Internal liræ of unequal lengths, usually not extending to the margin of the lip. Lenghth of shell, 70 mm., width, 30 mm. Length of canal and aperture, 40 mm.

This species resembles closely *Fasciolaria intermedia* Sow., from Santo Domingo, but the latter species is larger, much more solid, and lacks the fine transverse markings of the Chipolan shell.

Named in honor of M. G. Ramond of the Jardin des Plantes, Paris.

Locality.—Upper Oligocene of the Chipola River at Bailey's Ferry.

PYRAZISINUS Heilprin

Pyrazisinus Harrisi sp. nov., Pl. 28, figs. 2, 2a

Shell very solid, tapering rapidly, twelve-whorled. Whorls (except the terminal) with four equi-distant, raised spiral bands, and about 27 transverse ribs. In crossing these the bands are raised so as to appear as nodules. Terminal whorl with ten additional spiral bands, but as the transverse ribs become obsolete over the lower half, there are but four rows of nodules as with the the other whorls. On all except the two earlier whorls is a prominent, rounded varix (marking a period of retarded growth), over which the spiral bands are carried, but the transverse ribs are absent. Outer lip spreading; border much thickened within, in older specimens, but crenulated in younger. Sinus of varying depth. In many specimens the basal border of the outer lip extends to the columella and encloses a rounded aperture. Length of shell, 60 mm., width, 24 mm.

This species resembles both *Pyrazisinus campanulatus*, of the Orthaulax bed, and *Cerithium corrugatum*, from the Aquitanian of the Bordelais. It differs chiefly in its more prominent sculpture from *P. campanulatus*, and in its greater size and proportionately fewer whorls from *C. corrugatum*, which is, however, unquestionably its European analogue.

Locality.—Upper Oligocene of the Chipola River at Bailey's Ferry.

Georgia.

The Shell Bluff group—Eocene. Ruffin,[*] in 1843, described the bed characterized by *Ostrea Georgiana* at Shell Bluff, on the Savannah River, as resting upon the Jacksonian ('Great Carolinian' bed). This position would make the *Ostrea* layer either Jacksonian, or Vicksburgian.

Lyell,[†] however, in 1845, obtained typical Claiborne fossils from Shell Bluff, but there was some doubt whether they had been collected from the oyster layer.

In 1865, Conrad[‡] referred the bed to the oyster layer at the base of the Vicksburg Bluff, and proposed the name Shell Bluff group for the formation. Hilgard,* during the same year, adopted Conrad's correlation.

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[*] *Report Agri. Survey S. Car.*, 1843, pp. 22-3, 34.

[†] *Quart. Jour. Geol. Soc.*, 1, 1845, p. 437.

[‡] *Amer. Jour. Sci.*, 2nd ser., vol. 41, 1866, p. 96.

In 1895, Dr. Dall† placed the Shell Bluff group among the transitional beds overlying the Vicksburgian stage. During the same year, however, typical Eocene fossils were collected by Prof. Harris from the *Ostrea* bed. Several years later, Mr. Vaughan published a note to the effect that he had also obtained Eocene shells from this locality. The position of the Shell Bluff group in the Eocene was thus unquestionably established.

Vicksburg limestone. Vicksburg or Orbitoibes limestone, merging at the base into Jackson, from which it is with difficulty separable, extends as country rock over a much wider area in Georgia than Dr. Spencer‡ has assigned to it. As indicated on the map, it forms a broad belt running northeast and southwest across the state.

Remnant of Vicksburg limestone at Rich Hill. An interesting trace of its former northward extension was found by Prof. Harris, at Rich Hill, about 12 miles north of Fort Valley, and six miles east of Roberta. This remnant shows a regular *mauvaise-terre* structure. The beds containing fossils are on a hillside. The uppermost layers are reddish sands. These are followed by Vicksburg limestone with *Pecten*, *Scutella* and *Bryozoa* in abundance. Below are whitish, or bluish white, sands and clays. No sections were made, but it is estimated that about 100 feet of sands are exposed. This isolated remnant has, for some reason, resisted the erosion that has removed the rest of the limestone from the valley between Perry and Knoxville.

Time-interval between Vicksburg and Chattahoochee series. At Baindridge, Blue Springs and Wiley's Landing, on the Flint River, the Vicksburg is overlaid by beds of the Chattahoochee series. Prof. Pumpelly|| has noted near Bainbridge, indications of a time-interval between these limestone series. The

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* *Ibid.*, vol. 42, pp. 68-70.

† *Correlation Table*, 1895, p. 341.

‡ *Geol. Survey of Georgia*, First Rep., 1800-1.

|| *Amer. Jour. Sci.*, 3rd ser., vol. 46, p. 445-7.

evidences are, the presence, at the base of the Chattahoochee, of a conglomerate, usually formed of rolled limestone pebbles not distinguishable lithologically from the Vicksburg; the irregular surface between the Vicksburg and Chattahoochee series, and the presence of masses of chalcedonized corals between the series, which indicates a period of submergence.

Chattahoochee, Chipola and Alum Bluff beds. The red clay hills of the plateau region of southeastern Georgia have been shown by Dr. Pumpelly* to be formed of Chattahoochee at the base, overlaid by Chipola, which is, in turn, followed by Alum Bluff sands. These are doubtless continuations of the Florida beds.

Altamaha grits. On the Ocmulgee River are beds which correspond lithologically and faunally with the Hawthorne beds of central Florida. These beds were first described by R. H. Loughridge† as resembling the Grand Gulf sandstone. Dr. Dall‡ later named them the 'Altamaha grits.' The grits are developed in Irwin, Dodge, Ware, Tatnall and other counties. The grits represent a perizonal deposit formed under the same conditions as the Grand Gulf sandstones, and are, chronologically, nearly equivalent to the Hawthorne beds of Florida.

Alabama.

The White limestone. The Vicksburg limestone in Alabama, as in Georgia, is underlaid by Jackson, from which it can be distinguished only by the fauna. The two together form the White limestone that Tuomey|| described, in 1850, from exposures on the Alabama River. This is identical with the White limestone of St. Stephens on the Tombigbee. The latter was referred to in 1846 by Conrad§ as probably of the same age as the Vicksburg.

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* *Ibid.*, pp. 445-6.

† *10th Census*, vol.6, pt. 2, pp. 15-6.

‡ *Bull. U. S. Geol. Survey*, No. 84, p. 81.

|| *First Biennial Rep.*, *Geol. of Ala.*, 1850, p. 152.

§ *Amer. Jour. Sci.*, 2nd ser., vol. 41, 1866, p. 96.

Prof. Winchell,† in 1856, discriminated between the upper and lower beds of the White limestone, noting that *Orbitoides mantelli* is limited to the upper part of the formation.

Salt Mountain limestone. Messrs. E. A. Smith, Langdon and Johnson,* in 1894, found these divisions of the limestone present throughout its distribution in the state. At one locality, Salt Mountain, Clarke County, a third division was observed. This overlies the others, and is composed of hard limestone, characterized by corals and echinoderms. It attains a depth of 150 feet. The authors are inclined to think that it is a continuation of the Vicksburg series which it overlies.

The Vicksburg limestone. The Vicksburg division is a soft limestone, 140-150 feet thick, which hardens on exposure to the air. It is characterized by, and in layers composed of, the shells of *Orbitoides mantelli.*

Jackson limestcne. The Jackson division is a more argillaceous limestone, about 50 feet thick, and is characterized by bones *Zeuglodon*.

Grand Gulf series. The Grand Gulf sandstones reach their eastern limit in south central Alabama. Near Oak Grove, Florida, the typical sandstone beds pass beneath the Oak Grove sands, indicating that the sandstone is approximately of the same age as the Chattahoochee.

In Alabama the typical sandstone is rare. The series usually consists of clayey sands, or joint clays of a bluish, pink, purple, grey or creamy white color.

Chipolan species in Grand Gulf sands at Roberts. At Lovelace's Mill, near Roberts, a black sand, three or four feet in depth, was observed by Mr. Johnson. This was found to contain *Cardium chipolanum* and species of *Cardita*, *Lucina*, *Macoma*, *Arca*, *Pectunculus* and *Crassatella*. Dr. Dall correlates the bed with the Chipola division.

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* *Proc. Amer. Assoc.*, 1856, pt. 2, p. 85.

† *Rep. Coastal Plain of Alabama*, 1894.

Mississippi.

Vicksburg limestone. The Vicksburg limestone extends across Mississippi, forming as in Alabama, a narrow belt of 20 or 25 miles in width. In 1846, Conrad* noted the peculiar character of the fauna of this limestone. He writes, "The formation marks a distinct era in the American Tertiary system, intermediate to the Eocene and Miocene, but more nearly allied to the former, and perhaps it will be proper to class it as a subdivision of the Eocene.......A few of these shells have a striking resemblance to species from Dax, Grignon and Bordeaux, and I believe that the Vicksburg Tertiary will prove to have been deposited in an era more nearly allied in age to that of those localities than to the Eocene of Paris or London."

The typical Vicksburg beds are formed of crystalline limestones and marls.

The Red Bluff beds. At Red Bluff, in Wayne County, is a ferruginous rock, described by Dr. Hilgard† as the Red Bluff beds. These were considered by him as possibly equivalent to the Shell Bluff beds which were referred then to the Vicksburg. The Red Bluff beds are now considered to be hardly separable, faunally, from the Vicksburg of which they represent a lower phase, having more species in common with the Jackson beds.

Section at Mint Spring Bayou. A section of the Vicksburg limestone was made by Mr. Veatch, in 1900, along the course of Mint Spring Bayou, a small creek in the outskirts of Vicksburg. The strata are given in descending geological order.

Loess and Orange sand.	1. Yellow, fossiliferous-loess. *Helix* and loess *Kindchen*,	75 feet.
	2. Orange sand,	40 "
Vicksburg limestone.	1. *Arca* bed. A highly fossiliferous, blue and red, ferruginous marl, very glauconitic,	8 "
	2. Unexposed,	1 foot.

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* *Amer. Jour. Sci.*, 2nd ser., vol. 2, 1846, p. 124.

† *Geol. and Agri. of Miss.*, 1860, pp. 135-6.

3.	Hard, drab, fossiliferous limestone, glauconitic; forms the cap rock of the fourth falls,	6 inches.
4.	Soft, blue, glauconitic marl,	8½ feet.
5.	Indurated, fossiliferous, greyish marl, making a secondary cap,	1 foot.
6.	Soft, yellow, fossiliferous marl, undermined at base of falls,	4 feet.
7.	Slope between falls, unexposed,	4 "
8.	Indurated grey marl with few fossils. Forms cap of third falls,	2 "
9.	Soft, grey marl,	3 "
10.	Grey sandstone,	1 foot.
11.	Slope between falls, unexposed,	3 feet.
12.	Hard, grey limestone with *Crassatella* and *Cardium*. Upper six inches filled with *Pecten*. Forms cap of second falls,	23 "
13.	Drab colored marl. *Cytherea bed*,	4 "
14.	Dark, bluish-black, laminated, somewhat micaceous, lignitic clay,	9 "
15.	Slope between falls, unexposed,	6 "
16.	Same as 14, with a few faint casts,	7 "
	To water level of Centennial Lake,	200 "

A photograph, taken by Prof. Harris, of the falls is shown as the frontispiece. This represents typical Vicksburg limestone. The cap rock is the hard grey limestone with *Crassatella*, *Cardium* and *Pecten* (12). Beneath is the softer, drab colored marl with *Cytherea* (13), which is being undermined by erosion.

Species from Vicksburg. The material collected from the fossiliferous beds in Mint Spring Bayou and from an outcrop of the *Arca* bed on the Cemetery road contains the following species:*

Terebra divisurum Con.,	Arca bed.
" *tantula* Con.,	" "

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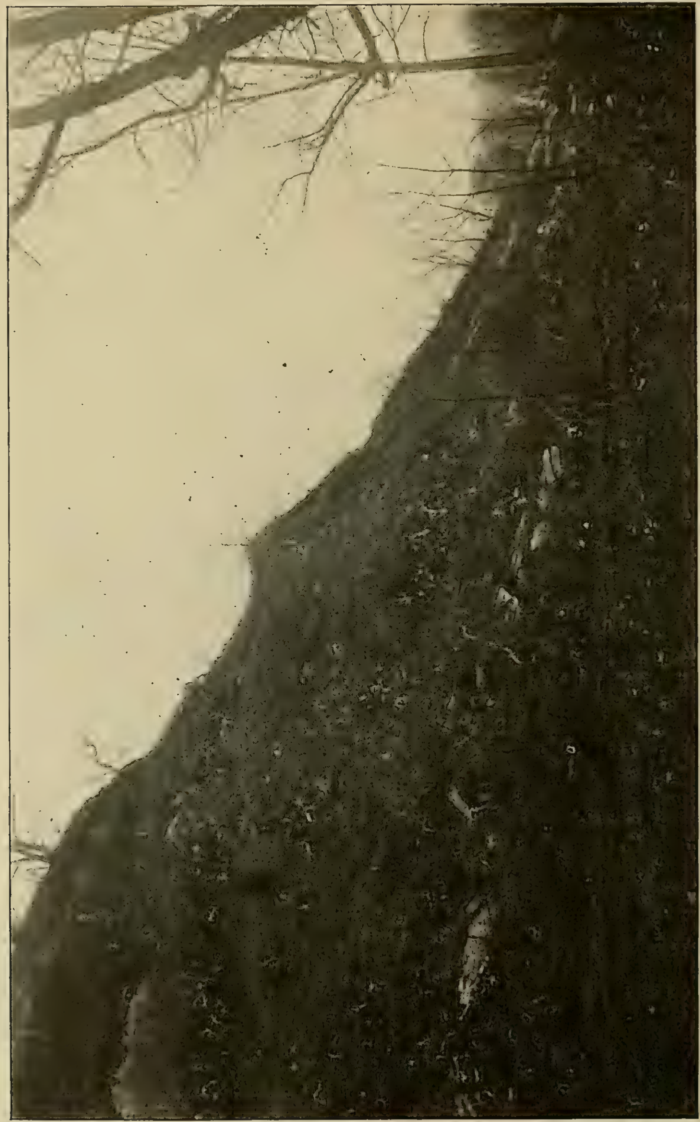
* The original descriptions of Conrad's Vicksburg species are chiefly in the *Proc. Acad. Nat. Sci.*, Phila., 1847; see also *Journal*, same Acad., 2nd ser., vol. 1, 1848.

Conus alveatus Con.,	Arca bed, Cemetery road.
Pleurotoma abundans Con.,	Cemetery road.
" " "	Arca bed.
" *albida* Perry,	" "
" *cristata* Con.,	Arca bed, Cemetery road.
" *decliva* Con.,	Vicksburg.
" *servata* Con.,	Arca bed.
" *tenella* Con.,	" "
" " "	Cytherea bed.
Cancellaria funerata Con.,	Arca bed.
" *mississippiensis* Con.,	Arca bed, Cemetery road.
Oliva mississippiensis Con.,	" " " "
Fulgoraria mississippiensis Con.,	Arca bed.
Caricella demissa Con.	Arca bed, Cemetery road.
Mitra mississipiensis Con.,	Cytherea bed.
" " "	Mint Spring Bayou.
Clavella, sp. indet.,	Cytherea bed.
Turbinella protracta Con.,	Arca bed.
" *Wilsoni* Con.,	Arca bed, Cemetery road.
Buccinum mississippiensis Con.,	Mint Spring Bayou.
" " "	Arca bed, Cemetery road.
Murex mississippiensis Con.,	Mint Spring Bayou.
" " "	Cytherea bed.
" " "	Arca bed.
Typhis curvirostratus Con.,	" " .
" " "	Mint Spring Bayou.
Triton crassidens Con. (fragment),	Arca bed.
" " "	Mint Spring Bayou.
" " "	Arca bed, Cemetery road.
Cassis cælatura Con.,	Cemetery road?
Cassidaria lintea Con.,	Arca bed.
Pyrula mississippiensis Con.,	" "
" " "	Cytherea bed.
Solarium triliratum Con.,	Arca bed.
" " "	Mint Spring Bayou.
Capulus americanus Con.,	Arca bed.
Calyptræa trochiformis Con.,	Mint Spring Bayou.
Narica mississippiensis Con.,	Arca bed, Cemetery road.
Natica mississippiensis Con.,	Mint Spring Bayou.
" *vicksburgensis* Con.,	Vicksburg.
Sigaretus misssissippiensis Con.,	Mint Spring Bayou.
" " "	Arca bed, Cemetery road.
Scalaria trigintanaria Con.,	Arca bed.
Dentalium mississippiensis Con.,	" "

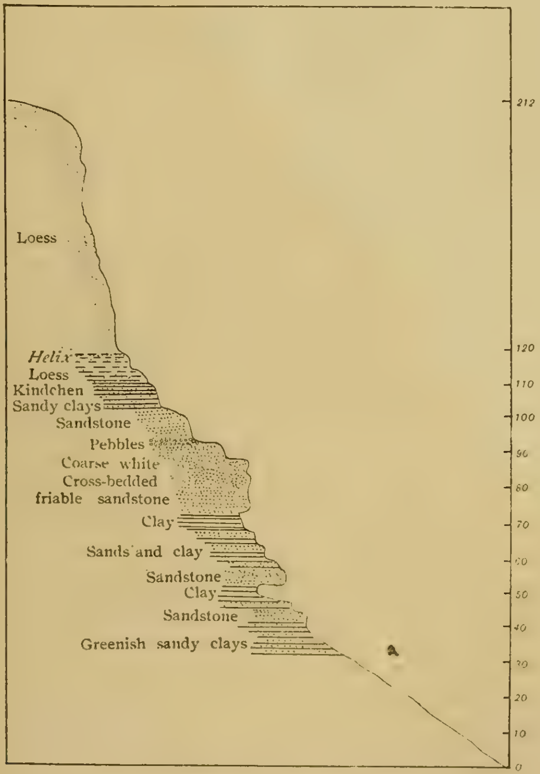
Ostrea vicksburgensis Con.,	Cemetery road.
Pecten Poulsoni Morton,	Arca bed, Cemetery road.
“ “ “	Mint Spring Bayou.
“ “ “	Cytherea bed.
Pinna argentea Con.,	Mint Spring Bayou.
Arca mississippiensis Con.,	Arca bed.
Byssoarca mississippiensis Con.,	Arca bed, Cemetery road.
“ “ “	Cytherea bed.
Pectunculus arctatus (?) Con.,	Arca bed.
“ *mississippiensis* Con.,	Mint Spring Bayou.
Nucula sericea Con.,	Arca bed.
“ “ (?) (young) Con.,	Mint Spring Bayou.
“ *vicksburgensis* Con.,	Arca bed.
Cardium diversum Con.,	Arca bed, Cemetery road.
“ “ “	Cytherea bed.
“ *glebosum* Con.,	“ “
Crassatella mississippiensis Con.,	Mint Spring Bayou.
“ “ “	Arca bed.
Cytherea astartiformis (?) Con.,	Mint Spring Bayou.
“ *imitabilis* Con.,	Cytherea bed.
“ “ “	Mint Spring Bayou.
“ “ “	Arca bed, Cemetery road.
“ *mississippiensis* Con.,	Mint Spring Bayou.
“ *sobrina* Con.,	Arca bed.
“ “ “	Cytherea bed.
“ “ “	Mint Spring Bayou.
Donax funerata Con.,	Arca bed.
“ “ (?) Con.,	Mint Spring Bayou.
Mactra funerata Con.,	Vicksburg.
Corbula alta Con.,	Cytherea bed.
“ *engonata* Con.,	Mint Spring Bayou.
“ “ “	Cemetery road.
“ , sp. indet.,	Arca bed, Cemetery road.
Panopæa oblongata Con.,	“ “ “ “
Lucina, sp. indet.,	Arca bed.
Tellina lintea Con.,	“ “
“ *perovata* Con.,	“ “
“ *vicksburgensis* Con.,	“ “
Madrepora mississippiensis Con.,	“ “
Orbitoides mantelli Morton,	Cytherea bed.

Grand Gulf sandstone. South of the Vicksburg belt are the Grand Gulf sandstones. These occupy a much wider surface area than the Vicksberg which they overlie, and attain a depth of about



THE BLUFF AT GRAND GULF (see page 75).

150 feet. The sandstones were first named by Wailes* from the bluff at Grand Gulf, of which a photograph is shown on the opposite page, where they are typical. Later they were described by Dr. Hilgard† as composed of coarse grains of pellucid quartz imbedded in a mass of opaque white silex. The formation contains gypsum and magnesium salts. The Grand Gulf sandstones are chiefly exposed along the Pearl River and tributaries of the Mississippi. Elsewhere they are likely to be obscured with Lafayette sands.


Loess
Helix
Loess
Kindchen
Sandy clays
Sandstone
Pebbles
Coarse white
Cross-bedded
friable sandstone
Clay
Sands and clay
Sandstone
Clay
Sandstone
Greenish sandy clays
212
120
110
100
90
80
70
60
50
40
30
20
10
0

SECTION AT GRAND GULF.

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* *Agri. and Geol. of Miss.*, 1st rep., 1854, p. 216.

† *Geol. of Miss.*, 1860.

Section at Grand Gulf (*see page 75*). A section at Grand Gulf, about half a mile above the town, was made by Prof. Harris in 1902. The most striking feature is the occurrence of a bed of pebbles above the coarse white sandstone. These mark the upper limit of the Grand Gulf series. The sandstone which occurs above the pebbles is a variable bed, poorly consolidated, and passes into sandy clays and loess. The alternation of sandy and clayey beds in the bluff is well marked by the effects of erosion.

Towards the southeastern part of the state the sandstones lose the typically arenaceous character which they exhibit at Grand Gulf, and merge into variously colored clays, often containing potash and soda. The clays are similar to those in Alabama.

Flora and fauna of Grand Gulf beds. The Grand Gulf beds in Mississippi contain abundant remains of dicotyledenous and coniferous trees and palms. The flora is richest in the upper beds of the series, at Hattiesburg, where the plant remains correspond to those of the Alum Bluff sands. Few animal remains have thus far been noted. A cast of *Unio* was found by Mr. Johnson, casts of freshwater bivalves by Mr. Meyer* and fragments of turtle by Dr. Hilgard.† The formation is thus shown to pass into freshwater beds to the westward of Alabama.

Louisiana.

The Vicksburg limestone. The Vicksburg limestone‡ appears in Louisiana only in the vicinity of Rosefield, and probably along Bayou Funne Louis. Mr. Vaughan|| has obtained typical Vicks-

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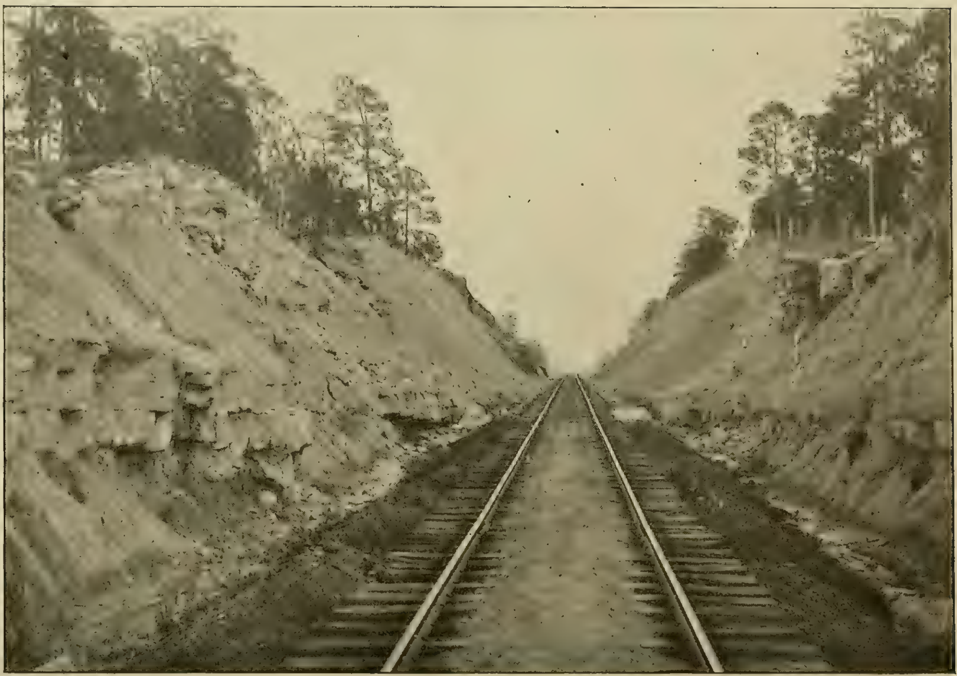
* *Amer. Jour. Sci.*, 3rd ser., vol. 32, 1886, p. 25.

† *Ibid.*, vol. 22, p. 59.

‡ Dr. Hilgard assigned a far larger area to this formation in Louisiana than recent investigation has shown it to occupy. (See Harris and Veatch, *Geol. Survey La.*, 1899, pp. 93-4). In 1869 (*Amer. Jour. Sci.*, 2nd ser., vol. 47, pp. 78-88), he refers nearly all the marine Tertiary of the state to the Vicksburg. See also the *Supplementary and Final Report of a Geol. Reconnaissance in La.*, 1883.

|| *Amer. Geol.*, vol. 15, 1895, pp. 205-229.



TYPICAL GRAND GULF SANDSTONE NEAR LENA, LOUISIANA (see page 77).

burg species from the former locality, and Dr. Hilgard* mentions a ledge of Vicksburg limestone with *Orbitoides*, *Arca mississippiensis* and *Pecten Poulsoni* along the Bayou. These outcrops form the western limits of the Vicksburg series.

Grand Gulf sandstones and clays. The Grand Gulf beds are interrupted by the Mississippi River and its wide alluvial plains, but they reappear at Sicily Island† and again near Harrisonburg. Passing thence across the state in a southwesterly and westerly direction, they enter Texas. A cut through typical Grand Gulf sandstone near Lena is shown in the photograph‡ on the opposite page.

In the southern portion of the Grand Gulf area, the sandstones merge into variously colored clays. In this, and in other respects, these beds present a close similarity to those of the same series in Mississippi. As in that state, the rugged surface topography of the sandstone area forms a marked contrast to the level plains which are underlaid by Vicksburg and Jackson limestones.

Flora and fauna of the Grand Gulf. The Grand Gulf beds in Louisiana, as in Mississippi, contain wood of dicotyledenous trees and palms, but no animal remains have yet been reported.||

During the past winter, a bed containing a number of *Unionidæ* was found by Prof. Harris at Chalk Hills, two and three-quarters miles south of Rosefield in the southwestern quarter of Section 7.

Unionidæ from Grand Gulf series. The fossiliferous layer, which is but five or six inches in thickness, is interstratified with white clays. The latter are popularly called chalk, and have

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* *Amer. Jour. Sci.*, vol. 30, 1885, pp. 266-269.

† See Darby, *Emigrant's Guide*, 1818.

‡ From *Geol. Survey Louisiana*, Harris and Veatch, 1899, facing p. 96.

|| The scarcity of organic remains was explained by Dr. Hilgard, in 1871 (*Amer. Jour. Sci.*, vol. 2, p. 348), as due to the temporary conversion of the Gulf of Mexico into a dead sea. In 1874, he abandoned this explanation in favor of the theory that the organic remains had been obliterated by the oxidizing influence of ferruginous solutions percolating from above. (*Ibid.*, vol. 7, 1874, pp. 208-210).

given rise to the name, Chalk Hills. All the specimens are in the form of casts. The matrix is a consolidated, light grey clay, very fine in texture. The casts show evidence of great pressure, which, in many cases, has resulted in their distortion. With the shells are beautifully preserved leaves of willow, birch and dicotyledonous trees, showing that land was adjacent to the shallows in which the deposition occurred. The material contains two new species of *Unio* and one of *Anodonta.*

UNIO Philipsson

Unio ? trigoniaformis sp. nov., Pl. 29, figs. 1, 2

Shell rather small, triangular, strikingly like *Trigonia* in form. Posterior end somewhat pointed, anterior rounded. Basal margin curved. Beaks large and prominent, placed at the anterior third of the shell. Valves apparently thin and light, sculptured, in the specimen described, by five, pronounced radial plications with interspaces of nearly equal width. The number and position of the plications varies in different individuals; in some they are obsolete in the anterior area, and, in general, they tend to be more marked towards the posterior area. At the ventral edge of the shell, the plications are prolonged beyond the interspaces, forming a sinuous margin. Lines of growth wavy, following the sinuosities of the base. Length of shell, 40 mm., height, 30 mm.

Portions of the casts show a punctate surface. This seems to have been caused by a foreign growth on the outer surface of the shell, forming encrustations analogous to those of *Microcoleus hyalinus* on recent species of *Unio* and *Anodonta.*

Unfortunately, no trace of teeth or of beak sculpture is to be seen.

This species is evidently not a member of the genus *Unio, sensu stricto* and it is only referred to that genus until more material is obtained by which the section to which it belongs can be definitely determined. That the species is a member of the *Unionidæ* can hardly be questioned when the characters of the shell and the forms with which it is associatrd are considered.

In some respects, this shell recalls the South American genus, *Castalia.*

Unio cretacollis sp. nov., Pl. 29, fig. 4

Shell of medium size, broadly elliptical, slightly winged at the dorsal margin. Posterior area marked off from the anterior by a rounded plication which passes from the beak to the posterior extremity. Beaks low, placed at the anterior sixth of the shell. Length of shell, 60 mm., height, 45 mm.

ANODONTA Lamarck

Anodonta Cornelliana sp. nov., Pl. 29, fig. 3, 5, 6, 7

Shell elongate-oval, apparently thin and light. Posterior extremity prolonged and sharply pointed, anterior rounded. Posterior area defined by a sharp carina, passing from the beak to the posterior extremity. Lines of growth delicately impressed. Beak rather prominent, placed at the anterior fifth of the shell. Beak sculpture concentric. Length of shell, 75 mm., height, 30 mm.

The Frio clays. The Frio clays have been traced by Mr. Veatch in the southwestern part of Louisiana. They overlie the Grand Gulf beds and are a continuation of the Texas formation which thins out and disappears in Louisiana.

Texas.

The Grand Gulf sandstones. The Grand Gulf sandstones continue from Louisiana into Texas, and pass through that state in a westerly and southwesterly direction, forming a belt of some 12 miles in average width.

Dr. Hilgard,* in 1871, suggested the continuation of the sandstone series from the Sabine to the Rio Grande Rivers. In 1880, this was confirmed by the observations of Mr. R. H. Loughridge,† who traced the sandstone from Trinity River to the Rio Grande by actual outcrops.

Mr. R. Penrose,‡ in 1889, named the formation the 'Fayette beds,' but regarded them as equivalent to the Grand Gulf series.

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* Miss. embayment, *Proc. Amer. Assoc. Adv. Sci.*, vol. 20, map opp. p. 222.

† *Census Report*, vol. 5, 1880, p. 679.

‡ *Rep. Geol. Gulf Tertiaries of Texas*, p. 47.

In 1895, Mr. William Kennedy* referred both the Fayette sandstones and the Frio clays to the lower Claiborne, because of the presence of *Venericardia planicosta* in the sandstones. Mr. Veatch, during the winter of 1902, has examined the sandstones and finds *Venericardia planicosta* is limited to the basal layers of the formation. These he refers to the Jackson; but the greater portion of the sandstones and the lower beds of the Frio clays he regards as Grand Gulf.

The sandstones are often cross-bedded and lenticular. Clays predominate in the upper part of the series.

Flora and fauna of Grand Gulf beds. The Grand Gulf beds contain abundant remains of palmetto, rushes, marsh grass and and other vegetation of a marshy habitat. The upper clays of the series are characterized by tree trunks which have become opalized by the infiltration of silex. There appear to be no indigenous animal remains, but a few have been reported washed in from neighboring beds.

The Frio clays. The Frio clays are a series of dark blue, red, green, brown and yellow clays, weathering to paler colors. The beds are more or less gypseous throughout. They are sometimes laminated, but usually massive. They overlie the Grand Gulf beds, and form a belt of nearly equal width. Mr. Kennedy† writes that they extend almost to the Louisiana line; but Mr. Veatch has shown that they continue for some distance into the state.

Fossiliferous bed in Frio clays near Burkville. The Frio clays have been thought to be fossiliferous only in central and western Texas, but Mr. Veatch found a fossiliferous layer near Burkville, not far from the eastern state line. The bed was about 100 feet above the base of the clays. The fossils are all in the form of casts. The matrix is a peculiar ferruginous rock, loosely consolidated and containing siliceous nodules with a geoditic structure. The fauna appears to be brackish.

Correlation of the Oligocene beds in the Southern States. A correlation of the Oligocene beds discussed in the preceding pages is given in the following table:

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* Eocene Tertiary of Texas, *Proc. Acad. Nat. Sci.*, Phila., 1895, pp. 92, 98.

† *Ibid.*, p. 94.

Correlation Table of the Oligocene of the Southern States.

		Central Fla.	Northern Fla.	Georgia.	Alabama.	Mississippi.	Louisiana.	Texas.
	Transitional.		Alum Bluff beds. Oak Grove sands.	Bainbridge residual beds.		Upper Grand Gulf sandstone. (Hattiesburg phase).		
	*	* * * *	* * * *	* * * *	* * * *	* * * *	* * * *	* * * *
OLIGOCENE.	Upper or Chipolan Epoch.	Tampa limestone.	Chipola marl.	Bainbridge residual beds.	Grand Gulf fossiliferous sands at Roberts with *Cardium chipolanum.*			
		Orthaulax bed.	Chattahoochee clays and limestones.	Bainbridge residual beds.	Typical Grand Gulf sandstone.	Typical Grand Gulf sandstone.	Frio clays. Grand Gulf sandstone.	Frio clays. Grand Gulf sandstone.
		Hawthorne beds.		Altamaha grits.				
	*	* * * *	* * * *	* * * *	* * * *	* * * *	* * * *	* * * *
	Lower or Vicksburgian.	Ocala limestone.			Coral lim'stn. (Salt M't'n).			
		Vicksburg limestone.	Vicksburg limestone.	Vicksburg limestone.	Vicksburg limestone.	Vicksburg limestone.	Vicksburg limestone.	
						Red Bluff beds.		

PART III.

COMPARISON AND CORRELATION OF THE OLIGOCENE OF THE SOUTHERN STATES WITH THAT OF WESTERN EUROPE.

Resemblances of the European Oligocene Fauna to That of the Southern States.

Foraminifera. That foraminiferal life reached a remarkable development during the deposition of the Vicksburg limestone is established by the fact that many layers of this rock are formed almost wholly of the remains of *Orbitoides*. The wide geographical distribution of this genus, from Florida to Louisiana, contrasts with the very limited area in which the nummulites flourished at a slightly later period.

A simultaneous developement of foraminifera occurred in western Europe. In the Adour limestone, *Nummulites intermedia* and other species abound. In the Gironde valley, the *Asterias* limestone contains *Archiacina armorica* in considerable numbers, while the limestone of Rennes is characterized by this species. In Germany, foraminiferal developement in the Oligocene period was somewhat later, occurring chiefly during the deposition of the Septaria clays.

Echinodermata. The Chattahoochee beds of Georgia and northern Florida show a developement of Echinodermata as rich as that of the analogous, but somewhat earlier, fauna of the *Asterias* limestone of the Gironde.

Comparison of molluscan species. Conrad was one of the first to attempt a comparison of the Tertiary molluscan species of Europe and America. In his check list* he enumerates some five species as common to both continents. Later, in 1833,† he added eleven, but in a subsequent article,‡ he rejected all except two of these, and added several others. Ultimately all were rejected excepting those originally published.

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*Smith. Miss. Col., No. 200, 1866.

†Tert. For., p. 34.

‡*Amer. Jour. Sci.*, 2nd ser., vol. 1, p. 219.

Dr. Lea,* in 1833, expressed a doubt whether a single American species would prove strictly analogous with a European form. Nevertheless he made several comparisons. Dr. Bronn,† in 1848, mentions a few American as synonyms of European species. Prof. Heilprin, in 1879,‡ 1884‖ and 1887,§ compared a considerable number of closely allied or identical forms among the Eocene and Miocene of the two continents. Under the Oligocene, he takes up only *Ostrea Georgiana* Con., which, he suggests, may be analogous with *O. crassissima* Lmk., of Europe. As the Shell Bluff beds containing *O. Georgiana* are now referred to the Eocene, no identical forms would be left in his grouping under the Oligocene.

Dr. Otto Meyer,** in 1884, from a study of some 706 German Tertiary shells and a number of American forms, found a few identical species, which are quoted in Heilprin's article of 1887. Dr. Dall,†† in his decription of the Florida Tertiary fauna, calls attention to a number of species analogous with the European, but the majority of these are Pliocene or Post Pliocene.

Oligocene species. The identical or closely allied species in the Oligocene of the two continents are but few. Among them are the following:

TRIFORIS PERVERSUS Linné

This species is cited by Speyer (Lippe-Detmold, p. 21) from the German Oligocene, and by Benoist (Cat., p. 340) and Degrange-Touzin (Le Thil) from the Gironde valley. Dr. Dall (*Trans. Wag. Free Inst. Sci.*, iii, p. 264) regards *Cerithium modestum*, C. B. Adams (Contr. Conch., p. 117, Ap., 1850) as a variety of *Triforis perversus*, and cites this variety from the Oligocene of the Chipola beds. It is also found in the Caloosahatchie

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* Contr. to Geol., p. 19.

† Index Palæontographicus, 1848-9.

‡ *Proc. Acad. Nat. Sci.*, Phila., 1879, pp. 217-225.

‖ *Jour. Acad. Nat. Sci.*, Phila., 1884, pp. 104-112.

§ Contr. Tert. Geol., 1887, pp. 83-101.

** *Proc. Acad. Nat. Sci.*, Phila., 1884.

†† *Trans. Wag. Free Inst. Sci.*, vol. 3.

Pliocene and living in shallow water from Cape Hatteras to the Antilles.

PYRAZISINUS HARRISI sp. nov.

This species from the Chipola marls, described on a preceding page, is closely allied to *Cerithium corrugatum* Basterot, from the Oligocene of the Gironde.

RISSOINA DECUSSATA Montagu

Helix decussata Montagu, Test. Brit., 1803, p. 399.

Cited by Benoist (Cat. p. 287) from the Gironde Oligocene. Dall (*Trans. Wag. Free Inst. Sci.*, iii, p. 343), Oligocene of the Chipola beds, Caloosahatchie beds, living in the Antilles and the Mediterranean.

CREPIDULA PLANA Say

Jour. Acad. Nat. Sci., Phila., ii, p. 226, 1822.

This species cannot be distinguished from *C. unguiformis* Lmk. (Dall, *loc. cit.*, p. 358). Oligocene of the Chipola marl, Miocene, Pliocene, Post-Pliocene. Recent on Atlantic coast. *C. unguiformis* Lmk. cited by Benoist (Cat. p. 275) from the Gironde Oligocene.

XENOPHORA CONCHYLIOPHORA Born

Trochus conchyliophorus Born, Mus. Caes. Ind., p. 333, 1778.

A variety of this species is found, according to Grateloup, in the Adour valley (Atlas, pl. 13, figs. 1, 2, 1840). This species is reported from the Cretaceous of Alabama and New Jersey, the Eocene of Wood's Bluff and Jackson, the Oligocene of the Orthaulax bed and the Tampa limestone, the Miocene, the Pliocene; living along the Atlantic coast from Cape Hatteras to the Antilles, and in the Gulf of Mexico.

AMPULLINA CRASSATINA (Lmk.) Desh.

Natica crassatina Deshayes, Anim. s. vert., 3, p. 58; 2, p. 171, pl. 20, figs. 1, 2.

Oligocene of the Adour, Grateloup (Atlas, pl. 6 (1), fig. 3); of the Gironde, Fallot (l'Étage Tongr. Gironde), Benoist (*Act. Soc. Lin.*, Bordeaux, 1885); of Mainz, Sandberger (Mainz Tert.,

p. 161, pl. 13, figs. 1, a, b), Lepsius (Mainz Beck); of Rennes, Vasseur (Ter. tert. de la Fr. occid,, pp. 334, 336), Tournouer (Tongr. de Rennes, p. 472); of the Paris basin, Cossmann and Lambert (Olig. d'Étampes, p. 55), Stanislaus-Meunier (Pierrefitte, p. 237). Dr. Dall (*loc. cit.*, p. 375) regards *Natica mississippiensis* Con. (*Proc. Acad. Nat. Sci.*, Phila., iii, 1847, p. 283) as a variety of the European species. *Ampullina crassatina* Lmk., var. *mississippiensis* Con. is reported from the Eocene of Alabama, and from the Oligocene beds of Red Bluff and Vicksburg, Miss. The variety is narrower and more elevated than the type (Dall).

BARBATIA ADAMSII (Shuttleworth) Smith

Arca Adamsii Smith, *Jour. Lin. Soc. Zool.*, vol. xx, p. 499, pl. 30, figs. 6, 6a, 1888.

Oligocene of the Chipola River and of Oak Grove, Florida. This species was identified by Adams with *Arca lactea* Lin. from the Aquitanian of the Bordelais (Degrange-Touzin, Le Thil). Dr. Dall (*loc. cit.*, pp. 629, 630) thinks certain minor differences sufficiently constant to distinguish the species, which are, however, unquestionably closely allied.

European Oligocene species in American Eocene and Miocene beds. It may not be without interest to note that a number of European species, or their analogues, are found in the American Eocene and Miocene beds, but have not been, as yet, reported from the Oligocene. Among these are the following:

Eocene.

TORNATELLA BELLA Conrad

Jour. Acad. Nat. Sci., Phila., 2nd ser., iv, p. 294.

According to Heilprin (Contr. Tert. Geol., p. 91), there is no difference between this Eocene species and the European *Auricula* (*Actæon*) *simulata* (*Bulla simulata*) Brander (Foss. hant., p. 29, pl. 4, fig. 61). By European authors it is usually placed in the genus *Tornatella*. Reported from European Oligocene by Nyst (Coq. et poly. foss., p. 423), De Koninck (Coq. foss. Baesele, p. 8), Koenen (*Pal.* 16, p. 121), Cossmann and Lambert (Olig. d'Étampes, p. 120).

PLEUROTOMA ACUMINATA Sowerby

Min. Conch., ii, p. 105.

European Oligocene, De Koninck (Coq. foss. Basaele, p. 24), Nyst (Coq. et poly. foss., p. 519, pl. 14, figs. 1, a, b). Eocene of Clarke County, Alabama.

PLEUROTOMA DENTICULA Basterot

Bass. Tert. du S. O. de la Fr., p. 63, pl. 3, fig. 12.

Oligocene of Germany, Koenen (Mit. Olig. N. D. *Pal.*, 16, p. 89); of the Adour, Grateloup (Atlas, pl. 20, fig. 8); of Belgium, Mourlon (Géol. de Belgique, 2, p. 196), Nyst (Coq. et poly. foss., p. 526), Van den Broeck (Feuille de Bilsen). Alabama Eocene specimens in the Nat. Hist. Museum in New York have been identified by Prof. Heilprin with this species (Contr. Geol., p. 94).

CANCELLARIA TORTIPLICA Conrad

This species is intimately allied with *Cancellaria* (*Buccinum*) *evulsa* Brander. The spire of the American species is slenderer and more elevated (Heilprin, Contr. Tert. Geol., p. 93). American Eocene.

Cancellaria evulsa is common in the Oligocene of northern Europe. It is cited by Speyer (Sollingen, p. 268), Nyst (Coq. et poly. foss., p. 477), Lepsius (Mainz Beck.), De Koninck (Coq. foss. Baesele, p. 10), Koenen (Mit. Olig. N. D. *Pal.*, 16, p. 71), Beyrich (Conch. N. D. Tert. *Zeits.*, 8, p. 556, pl. 26, figs. 2, a, b, c, 3, 4, 5).

PYRULA PENITA Conrad

Foss. Shells of Tert., p. 32.

Heilprin (Contr. Geol., p. 92) identifies this Eocene shell with *P. nexilis* Sol. *Pyrula nexilis* is reported from the German Oligocene by Beyrich (Conch. N. D. Tert. *Zeits.*, 6, p. 773, pl. 15, figs. 2, a) and by Speyer (Cassel, *Pal.*, 9, p. 187).

CERITHIUM TRILINEATUM Phil.

Enumeratio Molluscorum Siciliæ, vol. i, p. 195.

Meyer (Notes on Tert. Shells, *Proc. Acad. Nat. Sci.*, Phila., 1884, p. 105) finds this species and *Terebra constricta* H. C. Lea (*Amer. Jour. Sci.*, xi, p. 100, pl. 1, fig. 18), from the Claiborne Eocene, identical.

This European shell is reported from the German Oligocene by Speyer (*Pal.* 16, p. 211, pl. 23, figs. 9, a, b, c; pl. 24, figs. 1, a, b, and Sollingen, p. 278); from the Bordeaux beds by Degrange-Touzin (Le Thil) and Benoist (Cat. p. 336); and from the Paris basin Oligocene by Cossmann and Lambert (Olig. d'Étampes, p. 150, pl. 5, figs. 10, a, b, c).

SOLARIUM ORNATUM Lea

Contr. Geol., p. 120.

Bronn (Index Palæontographicus, 1848, p. 1153) considers this species synonymous with *S. stramineum* L. and *S. canaliculatum* Lmk. But Dall (*Trans. Wag. Free Inst. Sci.*, vol. iii, p. 324) says *ornatum* is a synonym of *canaliculatum* Con., but not of *canaliculatum* Lamarck. The American shell is found in the Alabama Eocene.

Mourlon (Géol. de la Belgique, 2, p. 196) reports *S. canaliculatum* Lmk. from the Oligocene of Belgium.

SIGARETUS CANALICULATUS Sowerby

Min. Conch., iv, p. 115, pl. 384.

Oligocene of Belgium, Nyst (Coq. et poly. foss., p. 449). Claiborne, Alabama Eocene, Conrad (Foss. Shells Tert., 2, p. 34).

OSTREA COMPRESSIROSTRA Say

Jour. Acad. Nat. Sci., Phila., iv, p. 132.

This Eocene species is found by Heilprin (Contr. Tert. Geol., p. 85) to be very close to *O. bellovacina* Lmk. The latter is cited by Nyst from the Oligocene of Belgium (Coq. et poly. foss., p. 318).

PSAMMOBIA EBOREA Conrad

Foss. Shells of Tert., 1st ed., p. 42.

According to Heilprin, this species is so close to *Solecurtus* (*Sanguinolaria*) *compressus* Sow. that, at first sight, they may be readily mistaken (Contr. Tert. Geol., p. 90). The American species is Eocene.

The foreign analogue is found in the Belgian Oligocene (Nyst, Coq. et poly. foss., p. 49).

Miocene.

SOLEN ENSIS Linn.

Heilprin (Contr. Tert. Geol., p. 99) considers that this species and *S. ensiformis* Con. (Foss. Med. Tert., p. 76, pl. 43, fig. 8), of the American Miocene, are identical. Var. *B.* Lmk. of *S. ensis* is reported by Nyst from the Belgian Oligocene (Coq. et poly. foss., p. 47).

SAXICAVA ARTICA Linn.

Syst. Nat. Ed., xii, 1767, p. 1113.

This species is found in the Oligocene of Germany, Speyer (Sollingen, p. 294, =*bicristata* Sandb.) and Koenen (Mit. Olig. N. D. *Pal.*, 16, p. 266); of Mainz, Lepsius (Mainz Beck.); and of Bordeaux, Benoist (Cat., p. 19).

It occurs in the American Miocene, Pliocene, Pleistocene, and living in temperate seas. Mayer (*Proc. Acad. Nat. Sci.*, Phila., 1884, p. 108) places *S. Jeurrensis* Desh., from the Oligocene of Étampes, and *S. bilineata* Con. as synonyms of *S. artica.*

Correlations of European Oligocene Beds with Those of the Southern States.

Conrad's correlation. Conrad, in 1866,* referred the Vicksburg limestone to the Oligocene beds of Beyrich, both series being characterized by a peculiar fauna, intermediate between Eocene and Miocene. In 1875,† Conrad states that he regards the Jackson as older Oligocene, and the Vicksburg as newer Oligocene. This confirms his earlier view, in 1846, that the faunal affinities of the Vicksburg group were stronger with the species of Dax and the Bordelais than with the Eocene species of the Paris basin.

The correlation of Conrad was, however, not generally accepted, and the Vicksburg was classed as Upper Eocene. The Chattahoochee series was placed in the Lower Miocene.

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* Check list foss. N. A., *Smith. Miss. Coll.*, No. 200.

† Geol. N. Carolina, vol. 1, 1875, Appendix A, p. 25.

Heilprin's correlation. In 1884 and 1887,[*] Prof. Heilprin referred the Nummulitic beds at Ocala, Florida, to the Italian, and, through the Italian, to the French Oligocene. The discovery of *Orbitoides ephippium* (*O. sella*), a Biarritz species, in the Vicksburg limestone at Loeneckers, on the Cheeshowiska River, in Florida, led Prof. Heilprin to refer the Vicksburg limestone also to the European Oligocene.

Dall's correlation. Dr. Dall, in 1892,[†] admitted the analogy of the Vicksburg and Ocala limestones with the European Oligocene, but strongly questioned the propriety of recognizing the American beds as constituting a distinct epoch, equivalent or analogous in value, to the Eocene, Miocene or Pliocene, Nevertheless, although Dr. Dall uses the terms Upper Eocene and Lower Miocene in reference to the Vicksburg and Chattahoochee series throughout the earlier portion of the "Tertiary Fauna of Florida,"[‡] in Part 4 of the article, the term Oligocene is adopted, but without explanation. In the Correlation Table[||] of 1895, Dr. Dall groups the Vicksburg, Chattahoochee and Grand Gulf series under the Oligocene, using the term as coordinate with the Eocene and Miocene. The Chattahoochee series is referred to the Aquitanian, the Shell Bluff group (of which the position is questioned) to the Tongrian, and the Vicksburg series to the Ligurian (Tongrian of Sacco). The Alum Bluff beds and Oak Grove sands are correlated, through the Deep River beds, with the Sausans (Gers) beds of France.

Summary and correlation. A comparison of the invertebrate faunas or the two continents offers but little evidence, either for or against the argument, that the Vicksburg and Chipola epochs may properly be referred to the Oligocene. Rather more European Oligocene species or their analogues occur in the American Eocene than in the so-called Oligocene beds. Some also are found in the American Miocene. Yet certain characteristic

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[*] Contri. to Tert. Geol.

[†] *Bull. U. S. Geol. Survey*, No. 84, 1892, p. 105.

[‡] *Trans. Wag. Free Inst. Sci.*, vol. 3, 1890.

[||] *18th Ann. Rep. U. S. Geol. Survey*, 1896, facing p. 334.

Oligocene species, or their varieties, are in the Vicksburg and Chipola beds, and as more of the Chipola species are described further similarities may be noted. This incomplete evidence, furnished by the invertebrates, is strengthened by the resemblances found by Scott and others between the vertebrate faunas of the two continents during the period.

The stratigraphic indications are also not decisive. The Paris basin Eocene (calcaire grossier) is represented by the Claiborne, and the European Miocene by the Chesapeake Miocene. Between both these equivalents are beds characterized by intermediate faunas. If the Vicksburg and Chipola beds were cut off from the Eocene and Miocene by stratigraphic breaks we should have to recognize them as corresponding to the Oligocene. But a far stronger unconformity exists between the Vicksburg and the Chattahoochee series than has yet been observed between the Vicksburg and the Eocene, or between the Alum Bluff beds and the Miocene. This would seem to indicate that the Vicksburg is really upper Eocene and the Chattahoochee lower Miocene, were it not for the very marked faunal difference, induced by change in elevation, between the Chipola beds and those of the Chesapeake Miocene. Although it is at present impossible to refer the Vicksburg and Chipola epochs to the Oligocene of Europe with absolute certainty, yet the balance of probability points in that direction.

Correlation table. A correlation table of the European and American beds which have been discussed in the preceding pages is appended.

The nomenclature of the Oligocene epochs in Europe is very variable. The system followed by the writer has been to use the term and its extension given in the region in which the deposits are most typical. Thus the Tongrian is substantially that of Dumont, the Rupelian that of Dumont as modified by Mourlon and later Belgian geologists, the Stampian that of Cossmann and Lambert, and the Aquitanian that of Mayer.

Comparative Stratigraphic Table of the Oligocene of Western Europe and the Southern United States.

		Germany.	Belgium.	Paris.	Brittany.	Gironde.	Adour.	Mainz.	Languedoc and Central Plateau.	Southern States.
OLIGOCENE.	TRANSITIONAL.									Alum Bluff beds. Oak Grove sands. Grand Gulf sandstone. (Hattiesburg phase).
	AQUITANIAN.	Lignite of the Rhenish provinces. Marine sands of Cassel and Bunde.	Plastic clays with Aquitanian flora (?).	Beauce limestone and Montmorency millstones. Clays of Étampes.	Freshwater limestone and clays of Rennes.	Grey limestone of Agen. Sandstone of Bazas. White limestone of Agen.	Marls of St. Paul and St. Avit.	*Corbicula* limestone. *Cerithium* limestone. Sandstone with leaf imprints.	Clays of La Limagne with *Helix Ramondi*. Blue clays with *Potamides*.	Chipola marl. Frio clays. Typical Grand Gulf sandstone. Chattahoochee clays and limestones.
	STAMPIAN.	Stettin sands. Septaria clays of Mecklenburg and Hanover.	Septaria clays of Boom. *Leda Deshayesiana*.	Sands of Ormoy. Sands of Pierrefitte.				*Cyrena* bed. Elsheim sands. Septaria clays.		
	RUPELIAN.	Cassel lignite.	*Nucula* clays. Berg sands.	Sands of Morigny. Marls of Jeurre. *Ostrea* clays, *Natica crassatina*.	Limestone characterized by *Archiacina* also containing *Natica crassatina*.	Limestone of Bourg with *Asterias*. *Ostrea* bed.	Limestone of the Adour with nummulites and *Natica crassatina*.	Marine sands of Alzey and Weinheim. *Ostrea* bed.	Limestone of Montredon.	Florida nummulitic limestone. Vicksburg *Orbitoides* limestone with *Natica crassatina* var. Red Bluff beds.
	TONGRIAN.	Magdeburg sands.	Vieux-Joncs marls. Neerrepen sands. *Ostrea* bed.	Limestone of the Brie. Clays. Gypsum?		Limestone of Civrac and of Castillon. Fronsac sandstone.				

Plate 28

Explanation of Plate 28.

		Page.
Fig. 1.	*Fasciolaria Ramondi* n. sp.	66, **376**
2.	*Pyrazisinus Harrisi* n. sp.	66, **376**
2a.	“ “	

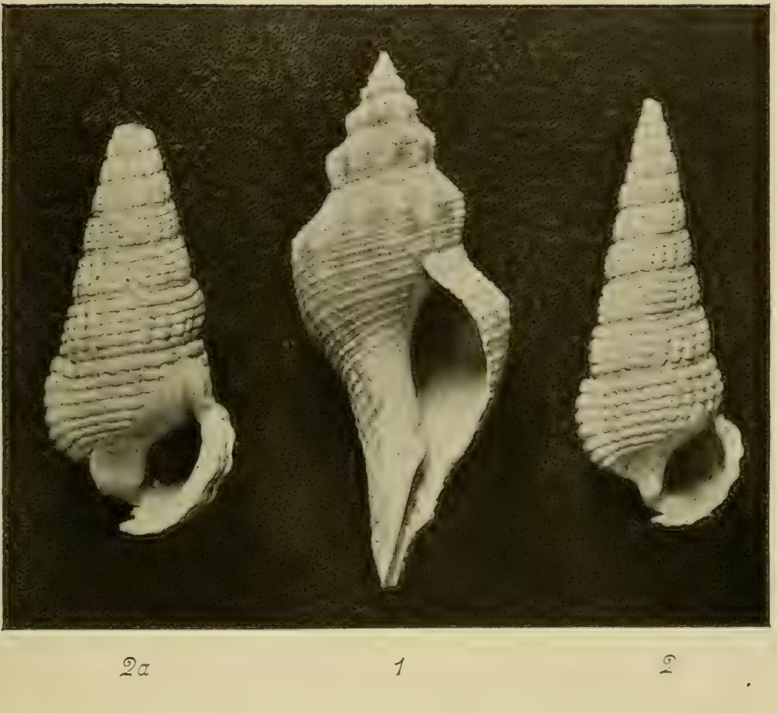

2a
1
2

Plate 29

EXPLANATION OF PLATE 29.

Page.

Fig. 1. *Unio? trigoniaformis* n. sp. 78, **388**
Imprint of exterior.

2. *Unio? trigoniaformis* n. sp. Cast.

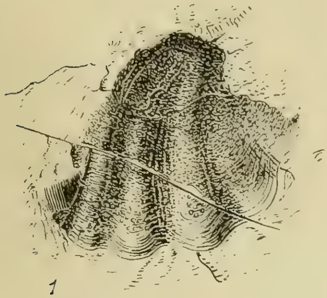
4. *Unio cretacollis* n. sp. 79, **389**

3. *Anodonta Cornelliana* n. sp. Anterior part.... 79, **389**

5. Posterior of presumably the same shell.

6. Same shell (young, broken).

7. Same shell (anterior missing).



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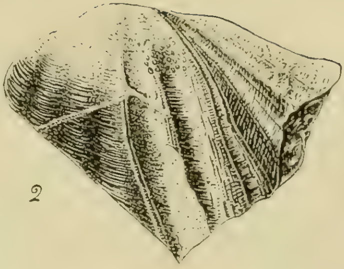

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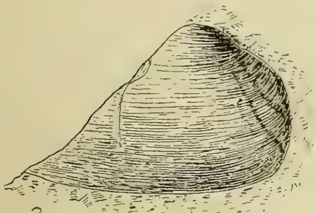

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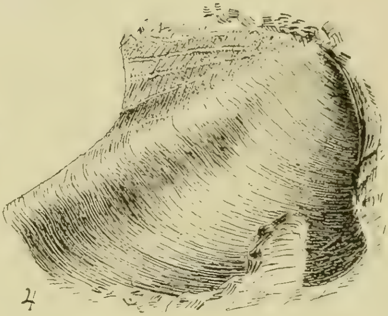

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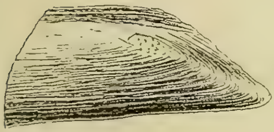

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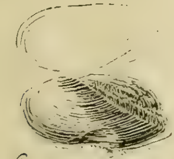

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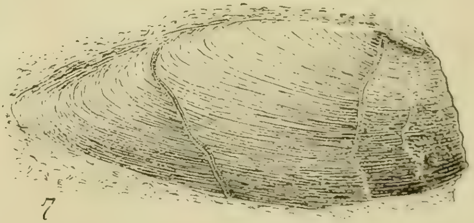

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Italic numerals indicate pages on which new genera, species, or varieties are described.

Italicized words indicate important references.

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